CHEMICAL & METALLURGICAL ENGINEERING

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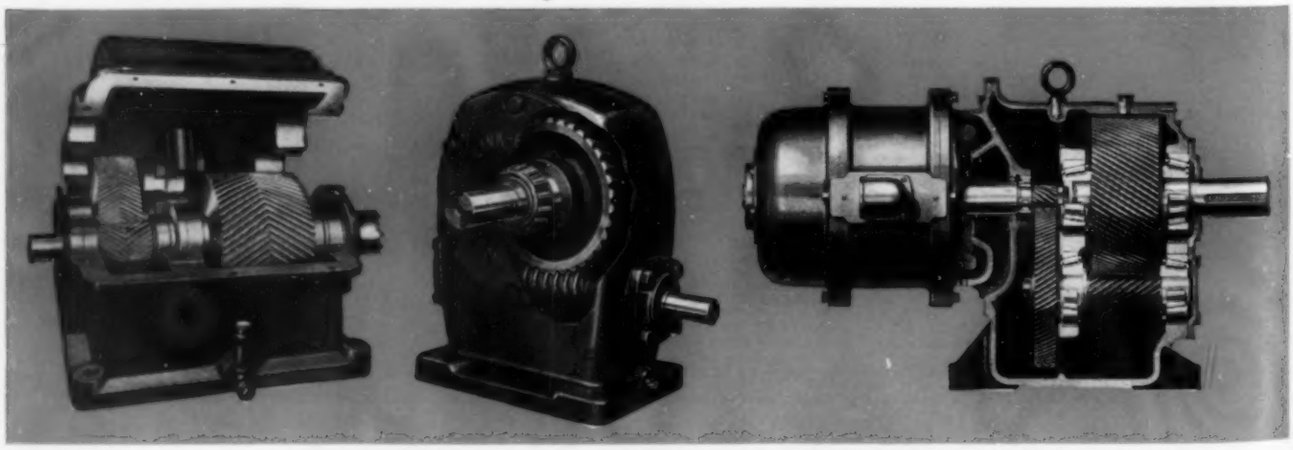


CHEMICAL & METALLURGICAL ENGINEERING

ESTABLISHED 1902

VOLUME 44 McGRAW-HILL PUBLISHING CO., INC. NUMBER 6

S. D. KIRKPATRICK, *Editor*

JUNE, 1937

A DEBT UNPAID

FOR MANY YEARS industry has been taking its pick of promising young men from the university faculties in chemical engineering departments. The practice usually proves so profitable for the man and the company that neither seem very much concerned about the university's loss. In fact that loss is not always immediately apparent even though it is cumulative and in the end is certain to lead to serious consequences. Unfortunately, some of our institutions are already so seriously threatened that something must be done to reverse the flow of good men and adequate funds back into teaching.

Today there is an alarming shortage of capable men for the departments of chemical engineering in some of the colleges where the need is most urgent. To fill such a position calls for a fully qualified chemical engineer—rather than a professional educator. Young men are wanted who have had adequate academic training, preferably including their doctorates, but in addition they should have five or six years of industrial experience—at least two of which are in responsible charge of important work. Those who have gone directly from college into teaching must make up for their lack of industrial experience by carrying on high-grade original research and engaging in important consulting work. Our present difficulty arises from the fact that desirable men of the former type too often decide to remain in industry while those of the other type become so over-burdened with the load of teaching that there is no time for research or outside consultation.

This problem of finding well-qualified men for universities will be most readily solved by voluntary action on the part of young engineers now employed in industry. If they are attracted by the human values and scientific and professional opportunities afforded by a career in teaching, they need only make known their demands. Salaries for teachers are proverbially lower than those in industry, but many university officials are now beginning to realize that they must pay on a competitive scale if they want qualified men. Certainly the salary trend is upward

In the case of industry the responsibility is much more direct. A large debt has been accumulating, for it is only in exceptional cases that men like Whitman, Newman, and Keyes have returned to university work after successful industrial experience. There should be more of these payments in kind. It is not asking too much to suggest that progressive, far-seeing managements in process industries should take a careful inventory of their chemical engineering assets. If among their technical personnel they find some good man, fully qualified for a successful career in chemical engineering education, that fact might well be made known to the president of some nearby university in need of personnel.

When an important position is thus filled, the management of that particular industry will undoubtedly benefit. Under-graduates trained in that institution would be better trained for its employment. Research undertaken by graduate students is likely to be of much more direct and practical interest. But most important of all, industry will have contributed its share in helping to liquidate a great debt to our educational institutions on which the whole future of our industries and profession must depend.

From an EDITORIAL VIEWPOINT

WORTH FIGHTING FOR

AN EPIDEMIC of state legislation regulating alcoholic beverages is plaguing industrial alcohol producers in many state capitals this season. Many of the attempts originate solely in the effort to control intoxicating beverages more effectively. But often the effect is to regulate or even prohibit industrial alcohol applications which have no comparable significance.

Chemical industries should concern themselves with these problems in every state in which they use alcohol or market products containing it. If they do not join forces with producers in having such legislation clearly and accurately phrased, to permit customary proper industrial uses of alcohol, they will find the substitution of some other solvent an almost necessary alternative.

T.V.A. AS FERTILIZER SALESMAN

WHEN Tennessee Valley Authority was established four years ago there was much distress in and no little opposition from the fertilizer industry. Naturally executives in that business then feared that the Government was going into competition with them and that unfair and detrimental effects were certain. Fortunately the experience of the first four years proves otherwise.

Perhaps never in the history of the fertilizer industry has there been so great a demand for plant food on the part of agriculture. Farmers everywhere are increasing fertilizer usage. The stimulus of soil conservation work under the Department of Agriculture is not a negligible factor in this. Generous cash income on the farm is another factor. But not a negligible consideration has been T.V.A.

That Government agency has not sought to go into business in the ordinary sense of the word. Its manufacturing operations on the large experimental scale have resulted in quantity production of concentrated plant food. But this material is not being sold but is all used for demonstration and educational work. In cooperation with Department of Agriculture officials the results are beginning to show. In some areas the demonstrations and training have been so successful as to create fertilizer demands far in excess of anything previously experienced.

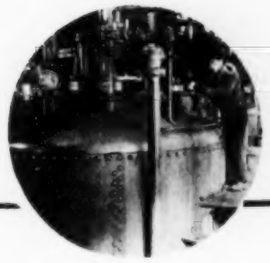
All of this is in line with the hopes and expectations voiced in these columns four years ago. But it is a pleasure to record the fact that progress is being made because the technical and administrative leaders of T.V.A. have been sound in their judgment and fair in their stand with reference to the fertilizer industry.

IN SERVICE OF MANKIND

CHEMICAL ENGINEERS who attended the Toronto meeting of the Institute returned with renewed respect and appreciation of the resources of our great Northern neighbor. Two of her most outstanding chemical developments—insulin and radium—bear striking evidence of her genius in applying the methods of science to the solution of Nature's most difficult problems. And both have as their common objective, the capture of an illusive ingredient, vitally needed for the cure of two of man's most serious diseases.

Insulin is, of course, a typically Canadian development, having been discovered by Dr. F. G. Banting and C. H. Best in 1921 while working in the laboratory of Professor J. J. R. Macleod in the University of Toronto. The process for the commercial production of the extract was largely worked out by Dr. J. B. Collop now of McGill University. As demonstrated to American visitors by D. A. Scott of Connaught Laboratories, the pancreas of the ox must follow a tortuous path of water, alcoholic, alkaline and acid extractions and precipitations, finally, to emerge as the carefully purified and standardized extract of the anti-diabetic principle—which has done so much to relieve man's suffering from what was previously an incurable disease.

Radium recovery in Ontario is an even more fascinating story of Canadian industry. Six years ago Gilbert LaBine discovered radium in the pitchblende of Great Bear Lake—on the rim of the Arctic Circle, thousands of miles from civilization. Despite its inaccessibility, a modern mining industry has developed and today is shipping its richly concentrated ore 4,000 miles by air, water and rail to the Port Hope refinery. Here under the guidance of one of Madame Curie's pupils, Dr. Marcel Pochon, a complicated chemical engineering process finally succeeds in capturing the equivalent of one gram of radium from every 6½ tons of pitchblende. But with a product worth from $25,000 to $30,000 a gram, there can be a considerable expenditure for chemicals (40 tons per gram of radium) and for efficient technique and equipment. The significant fact, however, is that here too is another great service of



chemistry to mankind. Canada has reason to be proud of her chemical industries and especially of these two widely different, yet closely related examples of efficient chemical engineering processes.

TWO DOGS IN ONE MANGER

ENGINEERING research should be encouraged by the Federal Government, just as agricultural research has been promoted over such a long period. There is ample justification for a program of engineering experiment stations. Such agencies could work effectively in connection with the engineering colleges and universities.

But this whole idea seems doomed to failure through the over-zealous support by individuals interested solely in the causes of their own institutions. Engineering educators connected with the land-grant colleges demand that they alone be recognized. Professors of other state-supported institutions demand that the states decide the issue and that land-grant schools should not be automatically recognized.

It is unfortunate that two engineering groups by failing to reconcile their differences should have discouraged Congressmen in any immediate support for the important basic idea. Engineering research will suffer from such selfishness.

FROM WHITE WINGS TO TEST TUBES

GONE are the horses and mules from the streets of New York but the white-garbed gentlemen with the shovels and the brooms are still on the job. And thus arises a problem in technological unemployment that our mighty mayor would have science solve.

Backed by W.P.A. funds, His Honor has prevailed upon New York University to erect on the campus at University Heights an elaborate three-story experimental laboratory. In this structure, with its unique equipment both as to physical plant and staff, a picked quota of street sweepers will be converted into sanitary engineers. And while they lay aside the push cart and broom and take up the microscope and test tube, the city promises to continue to pay each student his full salary. In return for this remarkable favor the former street cleaners are asked to sell their services to the city for a period of four years after graduation.

Many a young chemical engineering student in our community and elsewhere will doubtlessly be envious of this educational opportunity. Yet we should all remember that in these days of radical experimentation by a socially-minded federal government, it takes some really novel ideas to keep our mayor's name in the New York headlines.

MORE ABOUT BUYING PIGS IN POKES

ONE OF OUR GOOD FRIENDS in Europe was recently offered a "survey report" on certain American chemical research by the New York firm of J. J. Berliner and Staff. The price of $6 seemed quite modest but nevertheless the European company thought it worthwhile to investigate the material through its American consultant. The latter quickly discovered that the "survey report" was made up entirely of patent citations, extracts from articles published in *Chem. & Met.* and in the "Transactions of the American Institute of Chemical Engineers"!

More recently, the publishers of our contemporaries *"Soap"* and the *"American Ink Maker,"* learned through their subscribers that the Berliner firm had offered at a rather fancy price what purported to be an original research report on recent developments in waxes and polishes. Upon investigation these reports turned out to be made up largely of articles reprinted verbatim from *Soap* and other technical journals, without credit or mention of the original source of the material. Similar experience is reported by other publishers.

In its March, 1936, issue our esteemed contemporary, *Pulp and Paper Magazine of Canada* presented an unnecessary but gracious apology to *Chem. & Met.* for having published an article that plagiarized an address by Prof. W. P. Fiske, of M.I.T. which had first appeared in our issues of January and February, 1933. This article had been purchased in good faith by our Canadian friends from J. J. Berliner and Staff of New York.

In spite of these repeated warnings the Berliner firm continues its sharp and unethical practices. Eventually some publisher may be forced to take legal action for the protection of copyrighted property; but in the meantime it is well to remember that rackets thrive only because someone is willing to support them. To buy a "research report" from an unknown or questionable source brings racketeering just that much nearer to chemical industry.

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ANNOUNCING

PLANS FOR THIRD AWARD FOR CHEMICAL ENGINEERING ACHIEVEMENT

FOUR YEARS AGO this magazine first announced its plans for a unique award for chemical engineering achievement. In striking contrast with the multiplicity of medals, prizes and similar forms of recognition, this award is given to a *company* rather than to an *individual*, since its primary purpose is to encourage the type of coordinated group effort that results from a broader participation of the chemical engineer in the affairs of the process industries. His is seldom the task to create, in the restricted sense of original laboratory research, but rather to work with others in the translation of research into successful commercial production. Nor is this work confined solely to the design, construction and operation of chemical engineering processes and equipment. It encompasses all of the correlated duties and responsibilities of the technical executive—a field of activity for which the chemical engineer is admirably fitted.

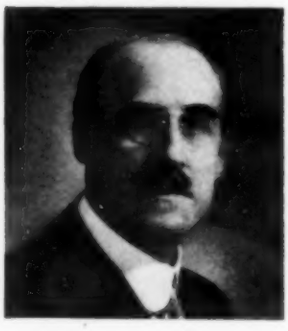
In 1933 the first award in this series was made to the Carbide & Carbon Chemicals Corporation for its major achievement in the building of a great synthetic aliphatic chemicals industry—a typically American development based on American research. Two years later the second award went to the Organic Chemicals Department of E. I. du Pont de Nemours & Co. Here the outstanding chemical engineering achievement was the commercial production of synthetic rubber and camphor.

As in preceding years, the third Award for Chemical Engineering Achievement is to be made to that company which, in the opinion of a representative committee of recognized leaders in the industry and profession, has contributed the most meritorious advance "made possible by the broader participation of the chemical engineer in the affairs of the process industries."

The Committee of Award, under the chairmanship of Dr. Martin Hill Ittner, president of the American Institute of Chemical Engineers, will welcome correspondence and suggestions from all readers of *Chem. & Met.*

MARTIN H. ITTNER

FREDERICK M. BECKET



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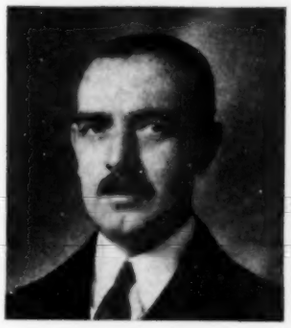

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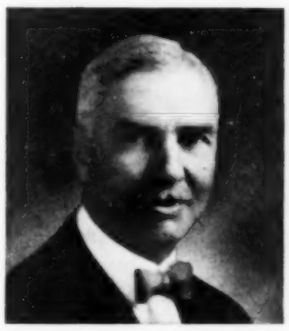


ALFRED H. WHITE

FREDERCK C. ZEISBERG

Rules and Conditions Governing

AWARD FOR CHEMICAL ENGINEERING ACHIEVEMENT

1. The purpose of this award is to give public recognition to that company in the process industries which, through the effective use of chemical engineering in any phase of its activities, has contributed the most meritorious advance to the industry and profession during the period under consideration.

2. The award consists of an appropriate bronze plaque suitably engraved to indicate the nature of the achievement and the name of the company to which it is presented. The Third Award for Chemical Engineering Achievement is to be made at the time of the National Exposition of Chemical Industries which will be held in New York City during the week of December 6, 1937. This award applies only to industrial developments that have come to fruition since December, 1935. Subsequent awards will be confined to developments occurring in the intervals between the National Expositions of Chemical Industries.

3. The award is to be made only to a company in the process industries since it is a recognition of the achievement of a corporate organization rather than that of any individual within a company. However, any company or any of its subsidiaries would be eligible for the award on the basis of any number of achievements brought to the attention of the Committee.

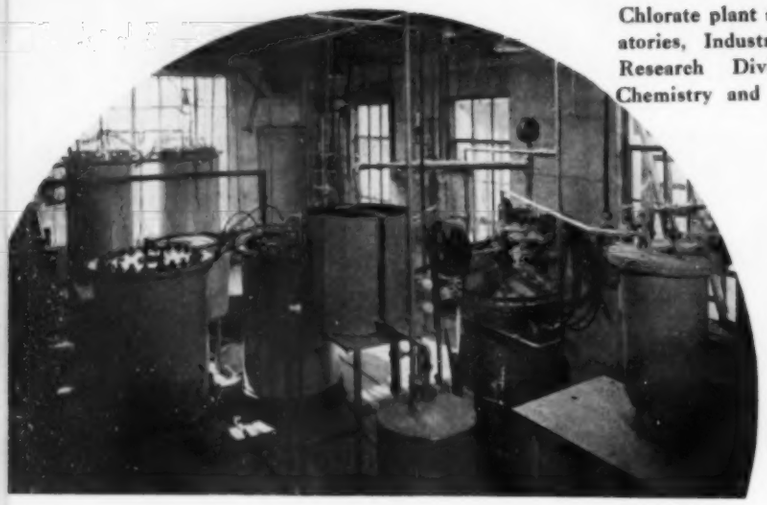
4. The Committee of Award shall consist of nine men, recognized as leaders in the industry and profession. One of the members of the Committee is to be designated as its chairman, and the editor of *Chem. & Met.* is to serve as secretary of the committee but without voting power. It is expressly understood that no member of the committee would be asked to pass on the merit of entries made by any company with which he is affiliated. In other words any member would have the privilege of withdrawing at any time should the consideration of a company's name prove likely to be embarrassing in personal or business relations. In such cases the member of the committee would be reported as "not voting."

5. It is to be the function of the Committee to review the achievements of the process industries, to receive suggestions from all sources and to determine which company has, in its judgment, contributed the most meritorious chemical engineering advance during the interval under consideration.

6. Any company in the process industries desiring to be considered for this award may file an application merely by answering the following inquiries:

(a) What is the nature of the achievement?
(b) During what period was it effected?
(c) To what extent have chemical engineers participated in this development?
(d) Are there any supplementary records, data, articles or references which you would care to include as pertinent to a fair consideration of this achievement?

7. It is expressly understood, however, that this award is not limited to those companies which file formal applications with the Committee. Suggestions are desired from any and all sources that will assist in directing the attention of the Committee to achievements of companies that should have consideration. All communications should be addressed to the Secretary, Committee of Award, *Chemical & Metallurgical Engineering*, McGraw-Hill Building, 330 W. 42nd St., New York, N. Y.



Chlorate plant at Arlington Laboratories, Industrial-Farm Products Research Division, Bureau of Chemistry and Soils, Washington

Electrochemical Production of SODIUM CHLORATE

*By P. H. GROGGINS and ASSOCIATES**

WEEDS levy an annual toll of about $3,000,000,000 on American agriculture. They cause a reduction in the quantity and quality of farm crops and livestock products. They necessitate increased labor and equipment costs on the farm. Weeds harbor disease organisms and insects and, finally, lands infested with noxious weeds suffer appreciable reductions in value.

Weed seeds are distributed largely by wind and sand storms, by irrigation canals, and by railway and motor vehicles. The individual farmer has no control over these natural forces or agencies, and experience has shown that regional or community effort is essential to control effectively weed infestation. Weeds which reproduce by creeping underground systems are the most difficult to eradicate. To a large extent, they can be suppressed by prolonged intensive cultivation and by cropping methods. For effective control over large areas, chemical herbicides have been found advantageous. Hundreds of chemical compounds have been suggested and tried, but it has been determined that these have practical limitations of one kind or another because of either (1) restricted efficiency as a herbicide, (2) effect on crops, (3) effect on soil, (4) effect on livestock, or (5) high cost of chemical agent.

By and large, the chlorates have the fewest drawbacks, and reports of field investigations indicate that sodium chlorate is probably the most effective general herbicide, being useful in practically all climates and soils. Recognizing the national scope and economic importance of the weed problem, Congress directed the Department of Agriculture to investigate the manufacture and use of sodium chlorate. The chemical engineering results of the investigation are here presented. The results reflect operations in a pilot plant capable of producing about 100 lb. of chlorate per day. During the course of the research, over 7,000 lb. of the herbicide were produced and shipped to stations carrying out field research under the direction of the Department's Bureau of Plant Industry.

The formation of sodium chlorate by the electrolysis of a brine solution is quite complex and is the culmination of a series of electrochemical and chemical reactions. The maintenance of high operating efficiencies depends on a number of factors such as temperature, hydrogen ion concentration, addition agents, etc. These are discussed later. The reactions known to occur in the electrolytic sodium chlorate cell are:

$$6\ \text{Faradays} + 6NaCl + 6H_2O \longrightarrow \underset{\text{Catholyte}}{6NaOH} + \underset{\text{Anolyte}}{3H_2 + 3Cl_2} \quad (1)$$

$$2NaOH + Cl_2 \longrightarrow NaOCl + NaCl + H_2O \quad (2)$$

$$2Cl_2 + 2H_2O \rightleftharpoons 2HOCl + 2HCl \quad (3)$$

$$NaOCl + 2HOCl \rightleftharpoons NaClO_3 + 2HCl \quad (4)$$

$$4NaOH + 4HCl \longrightarrow 4NaCl + 4H_2O \quad (5)$$

$$NaCl + 3H_2O + 6\ \text{Faradays} \longrightarrow NaClO_3 + 3H_2 \quad (6)$$

Reaction 1 is the basis of caustic-chlorine production in cells wherein a permeable diaphragm is employed to separate the anolyte from the catholyte. When the mixing of these primary products is permitted, the second reaction occurs with the formation of sodium hypochlorite. For the most efficient production of chlorate, the pH of the cell liquor should be controlled to insure the presence of hypochlorous acid, which, by interaction with sodium hypochlorite (eq. 4) results in the formation of sodium chlorate.

The over-all equation 6 constitutes the primary basis of cost calculations in the electrochemical production of sodium chlorate from sodium chloride. It is clear from the following equation:

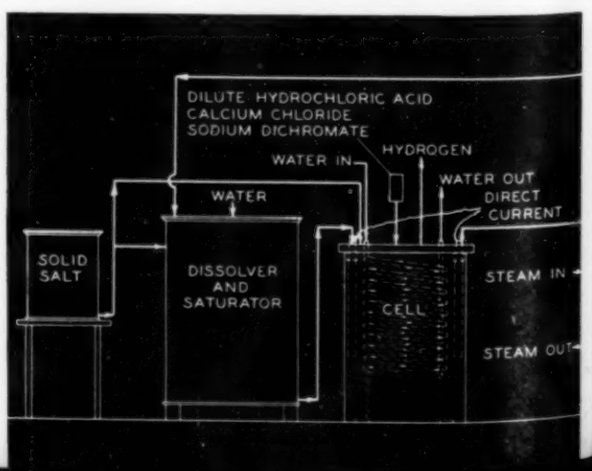
$$\underset{\text{Mol. wt. } 58.45}{NaCl\ \text{aq.} + 3H_2O} \xrightarrow{6\ \text{Faradays}} \underset{\text{Mol. wt. } 106.45}{NaClO_3\ \text{aq.}} + 3H_2\ \text{gas}$$

that a pound molar weight of salt, 58.45 lb., is required for the production of a pound molar weight of chlorate; i.e., 106.45 lb. On this basis, 1,100 lb. of salt are required to produce a ton of chlorate provided no losses of salt occur in the system.

$$58.45 : 106.45 :: 1{,}100 : 2{,}000$$

The cost calculations are based on the use of 1,150 lb. of salt.

Similarly, six faradays, or 160.82 (6 x 26.804) amp.-hr. are required to produce a gram of molar weight



276th Contribution from the Industrial Farm Products Research Division, Bureau of Chemistry and Soils, United States Department of Agriculture, Washington, D. C.

* Condensed from a report submitted by Dr. H. G. Knight, Chief, Bureau of Chemistry and Soils, U. S. Dept. of Agr., to the Appropriations Committee. Prepared by P. H. Groggins, A. L. Pitman, James McLaren and F. H. Davis.

(106.45 grams) of sodium chlorate. To produce a pound (453.59 grams) there will be required 685 amp.-hr.

106.45 : 453.59 :: 160.82 : 685.

At 82.5 per cent current efficiency, 830.0 amp.-hr. will be required. At an average cell potential drop of 3.2 volts, this corresponds to a power consumption of 2.66 kw.-hr. per lb. of chlorate. Because of other operating factors which are discussed later, the power cost is computed on the basis of 3.3 kw. per lb. of chlorate.

The operating technique is described in the following paragraphs and further illustrated in the flow diagram. Each cell was charged with a solution containing approximately 300 grams of salt per liter (2.5 lb. per gal.) and the current was continuously delivered until the chlorate concentration was approximately 525 grams per liter (4.33 lb. per gal.) and the concentration of the unconverted salt was about 125 grams per liter (1.04 lb. per gal.). During the course of the electrolysis, it was necessary to add salt as such, or as a concentrated brine, in order to maintain the salt concentration, and liquor volume and to avoid low current efficiencies. Small quantities of calcium chloride and potassium dichromate were added to the cell liquor to inhibit corrosion, and reduction of chlorate at the cathode.

At the conclusion of a run, the current to a cell or battery of cells was cut off and the solution was transferred to a steam-jacketed settling tank. Here, at a temperature of 80–90 deg. C., the fine particles of graphite were settled out and in the meantime the chemical reactions involving the formation of chlorate from hypochlorites were completed. After settling for 6 to 12 hr., the partially clarified supernatant liquor was pumped into a sand filter from which it flowed into the evaporator or still.

The isolation of the sodium chlorate from chlorate-sodium chloride solutions can be accomplished by a variety of methods. Indeed, this chemical engineering problem could be made the subject of a fruitful investigation. Some of the more important methods of accomplishing this step are: (1) Use of tubular evaporators equipped with salt filters, (2) Use of solar heat and settling tables, (3) Use of frigorific methods to throw out chlorate instead of salt, and (4) Use of jacketed, agitated vacuum stills.

In the present work the last procedure was used because suitable equipment was available. By means of jacket heat and under reduced pressure the cell liquor was concentrated to 50 deg. Bé at 100 deg. C. The condensate, containing small amounts of chlorate from evaporator spray, along with any other hot yater or waste heat, could be employed advantageously in the preparation of fresh brine for the cells. Because sodium chloride is less soluble than sodium chlorate at high temperatures, it was thrown out of solution in the course of the evaporation. The propeller stirrer in the still kept the salt in suspension until it was completely transferred to the salt filter.

Because both chlorate and chloride would be precipitated if the temperature of the still were permitted to fall, it was necessary, just prior to effecting the transfer of the charge from the still to the filter, to cut off the connection to the vacuum pump, open a vent, and raise the still temperature from 100 deg. C. to about 110 deg. C. The discharge lines from the still, through the filter, and to the crystallizer were warmed to avoid stoppage. The chlorate solution containing salt in suspension was withdrawn by a pump from the bottom of the still and delivered to the top of the filter. This was a cylindrical cast iron vessel containing a Monel metal filter screen. The rate of pumping was regulated so as to maintain a pressure of 10–15 lb. in the filter.

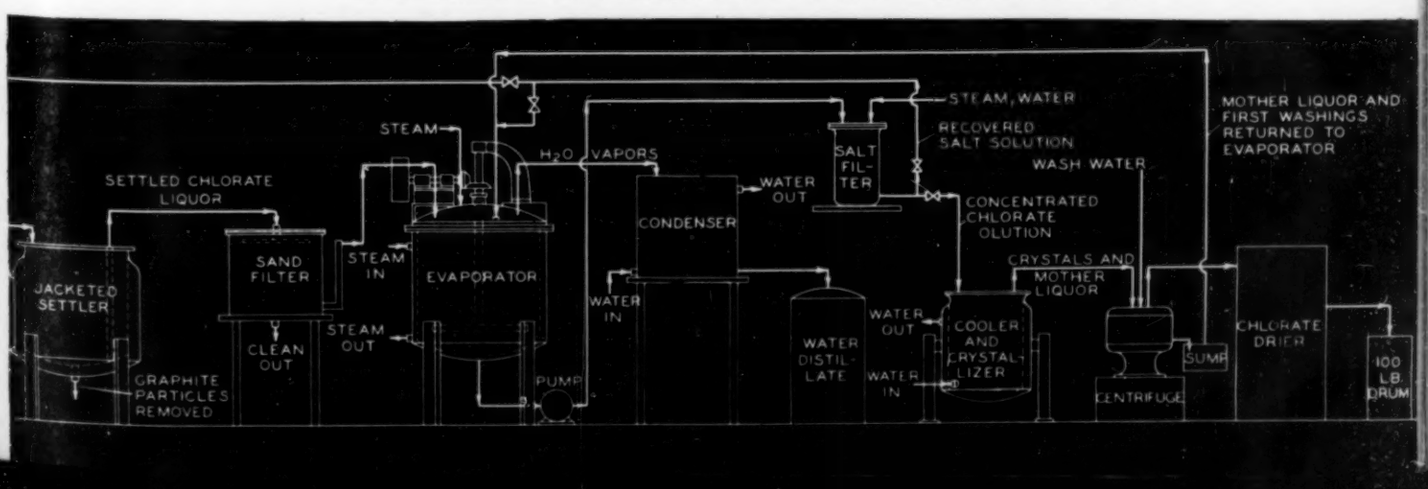
The first runnings through the filter were somewhat cloudy and this portion was returned to the still. As soon as a bed of salt was deposited on the filter, the filtrate was clear and this was run into an enamel-lined crystallizer. Upon completion of the transfer, the pump was stopped and the salt on the filter was washed by steam sent through the delivery line. This procedure insured against stoppage in pipe lines and resulted in removing most of the chlorate from the salt. The salt on the filter was then washed out with hot water and returned to the brine system for re-use in the electrochemical cells.

The hot, clear chlorate liquor in the water jacketed crystallizer was agitated and crystals of sodium chlorate were deposited in the yellow mother liquor. When the temperature of the batch had fallen below 30 deg. C., the chlorate was put on a centrifugal. Here the yellow film of dichromate on the crystals was removed by washing, first with previous wash waters and, finally, with fresh water. The mother liquors were generally returned to the evaporator, but periodically had to be returned to the cells because of increasing chromate concentration. The colorless chlorate crystals were removed from the centrifugal and placed on trays in a hot air dryer.

In the design and construction of the semi-works chlorate plant used in this investigation, consideration was given not only to the utilization of existing apparatus and facilities, but also to the subsequent employment of the plant for future electrochemical investigations involving agricultural raw materials. A brief description of the more important pieces of equipment is given here to afford a better appreciation of the operating flowsheet.

The motor generator set was a three-unit, 4-bearing set, capable of generating 1,500 amp. @ 7 volts or 750

Flow diagram used by Department of Agriculture for the electrochemical production of chlorates. A brief description of the equipment is given in this article.



amp. @ 15 volts. The board contained a watt-hour meter for the 60 cycle line which measured the total A.C. current supplied to the motor of the generator set; a voltmeter, 0-15 volts for reading terminal voltage; an ammeter, 0-2,000 ampere scale; and field rheostats for exciter field and generator voltage.

The distributing panel contained two circuits of 750 amp. each for operating the electrochemical cells and, in addition, six other circuits ranging from 25 to 150 amp. at 3 to 7.5 volts were provided for carrying out diverse small-scale experiments. By means of selector switches, ampere and voltage readings could be obtained for any particular circuit.

Electrochemical cells were fabricated from ¼ in. black iron plate and were 33 in. inside diameter. Two cells were 4 ft. tall, 2 cells were 6 ft. tall, and each was supplied with a 2 in. x 2 in. angle around the top perimeter for supporting the cover. The upper section of the cell was protected on the inside by the application of three thin coats of an asbestos cement. Thermostatically controlled cooling coils were employed to regulate the cell temperature in the later runs. These were connected cathodically and served also to reduce the cathode current density from 32 amp. to 15 amp./ft.²

The covers for the cells were made of ¾ in. impregnated insulating asbestos board. These were 36 in. in diameter and rested on the shoulder provided by the 2 in. x 2 in. angle. By packing with asbestos rope impregnated with silicate of soda, and then covering with a cement made of rosin and rubber, the covers were effectively sealed. Holes were drilled to accommodate the 24 anodes; cooling coil terminals; frangible disk, made by impregnating sheet asbestos and chlorinated rubber; thermometer bulb; gas vent; sampling tube; and leads for determining anode and cathode potentials.

The cell liquor containing particles of graphite was settled in a loose-covered, 150-gal. glass-lined steel-jacketed vessel, 32 in. I.D., by 38 in. deep. Steam at 15 lb. jacket pressure served to accelerate and insure completion of the requisite chemical reactions, while graphite sedimentation was progressing. The black sludge was removed periodically by means of a bottom outlet.

The sand filter was a covered, steel, cylindrical vessel, 26 in. I.D., by 22 in. in height. An expanded metal false bottom supported on a 1 in. by 1 in. angle, fastened to the inside perimeter 4 in., from the bottom, carried the graded quartz pebbles and sand. A side arm overflow kept a body of liquor in the filter. The incoming solution was distributed by means of a perforated plate resting on the sand bed. By periodic countercurrent-washing the filter was kept in good operating condition.

The evaporator was a jacketed still, 26 in. I.D., 22 in. high, provided with a propeller agitator which kept the precipitated salt in suspension. Jacket steam up to 25 lb. pressure served as the heating agent.

The suspension of salt in hot chlorate liquor was delivered under pressure to a cast-iron vessel 12 in. I.D., by 24 in. tall. The salt was deposited on a double Monel metal screen, 40 x 40 mesh, 0.013 in. opening, which was placed 8 in. above the conical bottom outlet. Top connections were provided for (1) incoming charge, (2) steam and water, (3) pressure gage, and (4) vent. At the base, the piping permitted (a) return of filtrate to evaporator or other reservoir, (b) flow of chlorate solution to crystallizer, and (c) transfer of leached salt to brine tanks.

To insure a colorless product, the hot chlorate liquor was cooled and crystallized in a glass-lined vessel, which was of 50-gal. capacity and provided with an agitator and a jacket for circulating water. Almost any type of centrifugal can be employed.

Cells Operated on Batch Basis

A hot air dryer of the Hurricane type gave satisfactory service in reducing the moisture content of the crystals to about 0.2 per cent. The drying trays for sodium chlorate should, preferably, be made of or lined with a stainless steel alloy to avoid rusting and discoloration of the product. The sodium chlorate was packed in 12-gal., single-trip, steel containers which comply with I.C.C. specifications for Class 6-F. These drums were fitted with paper liners and held 100 lb. net.

In order to simplify the research problem at the start, the cells were operated on a batch basis. It is recognized, however, that a continuous parallel flow of

Table I. Sodium Chlorate: Electrolytic Cell Conditions

Cell Run. No.	1	2	3	4	5	6	7	8
Make of anodes	X	Y	Y-T	X-T	Y	X-T	Y	Y
No. of days run	67	67	63	63	39	49	32	32
Chlorate made (lbs.)	1160	1220	1120	1150	645	660	1083	1043
Amperage	688	688	685	685	632	618	1121	1121
Voltage:								
(a) Initial	3.1	3.1	3.1	3.1	2.9	2.9	3.4	3.2
(b) Flush	3.6	3.6	3.5	4.2	3.1	3.4*	3.6	3.3
Current density:								
(a) Anode (amp/sq. cm.)	0.018	0.018	0.018	0.018	0.019	0.018	0.019	0.019
(b) Cathode (amp/sq. cm.)	0.035	0.035	0.035	0.035	0.018	0.017	0.015	0.015
Addition agents (gm./lt.)								
(a) Sodium dichromate	1	1	1	1	1	1	2	2
(b) Calcium chloride	3	3	3	3	0	0	1	1
Amperes per liter of solution	0.73	0.73	0.73	0.73	1.12	1.10	1.29	1.29
Temperature (°C.)	43.7	42.8	44.8	46.4	42	42	32	42
Hydrogen ion conc., (as pH)	7–8 ?	7–8 ?	7–7.5	7.0	7–7.2	7–7.2	Av.6.91	Av.7.06

Runs 1 to 4 inclusive, exploratory, to test suitability of various anodes.
"X" and "Y" represent manufacturer's untreated anodes.
"X-T" and "Y-T" represent corresponding manufacturer's linseed oil treated anodes.
* Of the final voltage 0.3 volt is due to calcium chloride, 1 gm. per liter, added two weeks from the end.

Discussion of Experimental Operations

After use, the anodes were leached in warm water, dried at 80°C., removed and weighed until constant in weight. Runs 5 through 8 were made in cells containing internal circular cooling coils, also used as cathodes. In these runs cell temperatures were maintained thermostatically. In the course of Runs 5 and 6 current interruptions resulted in a marked lowering of current efficiency immediately thereafter. This was traced to reduction at the cathode.

Table II. Efficiencies: Graphite Consumption

Cell Run No.	1	2	3	4	5	6	7	8
Efficiencies to the End of Runs								
Electrodes	X	Y	Y-T	X-T	Y	X-T	Y	Y
Current efficiency	75 2	79 0	75 3	77 6	74 3	62 2	86 2	83 0
Kw.-hr./lb. chlorate	3 16	3 06	3 14	3 11	2 76	3 29	2 82	2.79
Mols $NaClO_3$/1	5 25	5 50	5 08	5 23	4 77	4 99	5 30	5.14
Mols NaCl/1	1 66	1 50	2 17	2 14	2 34	2 40	2 16	2.31
Efficiencies to Selected Concentrations								
Electrodes	X	Y	Y-T	X-T	Y	X-T	Y	Y
Current efficiency	79 1	83 1	80 3	80 8	79 0	69 8	88 8	85 2
Kw.-hr./lb. chlorate	3 04	2 86	2 82	2 85	2 76	2 95	2 73	2.73
Mols $NaClO_3$/1	4 15	4 00	4 05	4 03	4 27	4 11	4 65	4.50
Mols NaCl/1	1 79	1 80	2 74	2 56	2 11	2 22	1 92	2 36
Graphite Consumption								
Electrodes	X	Y	Y-T	X-T	Y	X-T	Y	Y
Machined wt. of anodes (lbs.)	208	212	230	200	192	196	317	330
Wt. loss (per cent)	8.4	6.9	2.8	?	5.8	6.7	1.8*	3.4*
Lbs. loss/ton chlorate, basis of 30% orig. wt. as stump loss	43	37	16	?	49	57	11*	21*

"X" and "Y" represent manufacturer's untreated anodes.
"X-T" and "Y-T" represent corresponding manufacturer's linseed oil-treated anodes.
* Estimated: Based on loss as CO_2 as measured, plus assumed equal sludge loss = actual graphite loss.
More recent investigations indicate that the Kw.-hr./lb. $NaClO_3$ can be reduced about 0.3 Kw./hr.

electrolyte through a large number of cells connected in series is conducive to better temperature and pH control of the cells, and more efficient handling of the cell liquors in the subsequent operations.

The results obtained in a series of eight runs are summarized in Table I and II. Because the experimental operations closely simulated industrial practice, the experience and data made possible reasonably accurate and sound information regarding (1) problems of plant maintenance, (2) electrochemical efficiency of cell operations, (3) anode attack, (4) cost of plant construction, and (5) an insight into mechanical difficulties and corrosion problems. On the basis of the data and experience, estimates on the cost of production have been prepared.

Sodium Chlorate Costs: General Considerations

Itemized statement based on 6,000,000 lb. annual production, 500 000 lb. monthly production, 16,700 lb. daily production. Minimum output per cell per month = 625 lb.

Number of cells required = 800.

Installation plan: 10 circuits of 80 cells each; converter set, 2500 kw. @ or ¢ 280 volts; capable of delivering (2500 x 24) 91% = 55,000 kw.-hr. (D.C.) per day. Estimated requirements (16,700 x 3.3) = 55,000 kw.-hr. (A.C.) per day, or 46,760 kw.-hr. (D.C.) per day.

Table III. Material and Power Costs

	Per Ton $NaClO_3$
Material costs:	
Salt, 1150 lb. @ $7.00 per ton	$4.02
Muriatic acid, 34 lb. @ 1¢ per lb.	.34
Sodium bichromate, 8 lb. @ 6¢ (66% recovery)	.16
Calcium chloride, 4 lb. @ 1¢ per lb.	.04
Total chemical costs per ton chlorate	$4.56
Total chemical costs per pound chlorate	0.23 c.
Electric Power, A.C.:	
3.3 kw.-hr. per lb. of chlorate at 3.05 mills per kw.-hr. Includes conversion losses of 10-12 per cent, voltage drop in bus bars to cells, and an added power charge of 5 per cent due to losses incurred in process of obtaining chlorate as crystals.	$1.00
Total chemical and power costs per lb. chlorate	1.23 c.

Table IV. Monthly Operating Costs

	Cost per month
Operating labor; cell room, 3 shifts	$1,120.00
Operating labor, finishing, 3 shifts	1,120.00
Drying and packaging: 3 shifts of 1 man	390.00
Salt preparation; 2 men, day shift	312.00
Relief labor, 6 men	780.00
Repairs labor; 6 men	1,120.00
Supplies and repairs material	300.00
Works expense and plant repairs	150.00
Direct superintendence	600.00
Laboratory expense	700.00
Total	$6,592.00
Cost per pound of chlorate	1.32 c.

Table V. Auxiliary Power Costs

Compressed air	$20.00
Electric power for motors and lights	150.00
Water for processing and cooling	40.00
Steam for processing, drying and heating	1,100.00
Total Charges	$1,310.00
Cost for auxiliary power per pound chlorate	.26

Table VI. Motor Requirements

	No. of Motors	Rated h.p.	Daily h.p. hours
a. Pumping brine	1	10	120
b. Purification of brine	2	20	160
c. Transfer of cell liquor	2	10	240
d. Pumping settled chlorate liquor to sand filter	1	5	60
e. Pumping evaporator charge to filter	1	5	60
f. Returning mother liquors and wash waters from centrifugal	1	5	60
g. Centrifugals	2	7.5	180
Total			880
Estimated daily load, h.p. hours			700

The material and power costs are summarized in Table III. The indicated consumption of materials is based on experimental data and the commodity prices represent typical commercial quotations.

Theoretically, 685 amp.-hr. are required for the electrochemical production of one pound of sodium chlorate. The current efficiency of cells which contain 2 grams per liter of sodium bichromate as an addition agent ranges from 90 to 80 per cent, it being lowest toward the end of the run when the salt concentration is lowest. The conservative figure of 82.5 per cent efficiency is used here. Allowing for a loss of 5 per cent in working up cell liquors to chlorate crystals in drums, we have:

$$\frac{685}{0.825 \times 0.95} = 874 \text{ amp.-hr. per lb. of chlorate.}$$

The potential drop across the cell varies from 2.8 volts for clean cells to 3.6 volts for those containing lime, rust, etc. Using the average, 3.2 volts, there is an indicated power consumption of 874 x 3.2–2.80 kw.-hr. (D.C.) per lb. of chlorate. This figure must be augmented to include energy losses of about 10-12 per cent in transforming A.C. current to D.C. current, as well as bus bar and other minor losses of about 4 per cent. This gives a final power charge of 3.3 kw.-hr.

$$\frac{2.80}{0.88 \times 0.96} = 3.3 \text{ kw.-hr. (A.C.) per lb. of chlorate in drums.}$$

The rate assumed for power, 3.05 mills per kw.-hr. is based on rate schedules available under contracts with the Tennessee Valley Authority (See article by Curtis et al., *Chem. & Met.*, page 648, Dec. 1936).

Operating Expenses

Operating expenses for labor and direct superintendence are shown in Table IV. The cost estimates are based on an 8-hour shift and 25 work days per month. Wages range from $200. per month for shift foremen to $1.00, $0.75 and $0.65 per hour for mechanics, operators and laborers, respectively. Adequate provision is made in the estimates for shift relief and special labor, as well as works expense and plant maintenance and repairs.

In Table V are presented the monthly charges for auxiliary power. It is assumed that the plant design will provide suitably for gravity flow of materials in process. Lighting, about 240,000 lumens, will be required for 16,000 sq. ft. of operating buildings; and 8,000 sq. ft. of offices, laboratories and yards. Water at the rate of 500 gal. per min. is needed for (1) the preparation of brine, (2) cooling of cell liquor, (3) condensing distillate from evaporators, and (4) washing of chlorate crystals. The motor requirements are set forth in Table VI, and these, as well as other auxiliary power charges, are computed at 4 mills per kw.-hr.

Steam is taken in at 40 c. per 1,000 lb. and is required principally as follows:

	Lb. Steam/Lb. $NaClO_3$
1. Concentration of cell liquor and wash water	3.0
2. Drying of chlorate crystals	0.5
3. Heating of buildings, etc.	1.0
4. Condensation and incidental uses	1.0
Consumption per pound of chlorate	5.5

Anode replacement will vary with the conditions employed; e.g., temperature, current density and protection of graphite sticks at surface of the electrolyte. It has been found that the rate of anode attack is definitely a function of temperature. Other factors being equal, the graphite losses at 32 deg. C., as measured by CO_2 content of evolved gases, is only about one-half of the losses at 42 deg. C.

From our limited experimentation and observation, it is believed that a set of 2 in. x 2 in. x 36 in. anodes will be an agency for the production of about 20,000 lb. of sodium chlorate. This estimate is based on the replacement of the anodes when they are approximately 1 in. in diameter, thus allowing for the removal of 70 per cent of the original graphite. Allowing for about 10 per cent breakage and for the replacement of anode connections, the cost of anodes per cell will be $50. This leads to an anode cost of 0.25c. per lb. of sodium chlorate. Operations employing continuous flow of electrolyte through the cells in series should certainly not tend to increase this figure.

Advantages of Using Chlorate Liquor

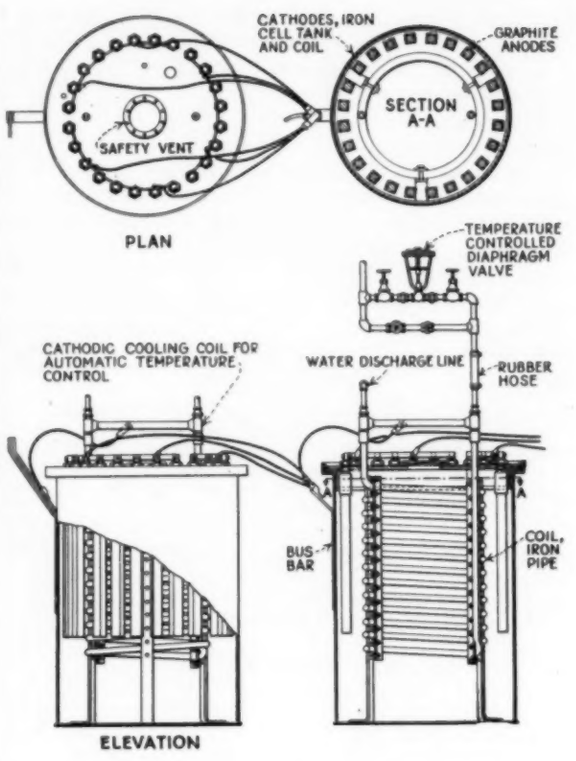
Shipments of sodium chlorate are generally made in I.C.C.-approved, single-trip containers of 100-lb. capacity. These cost 36c. each and constitute an important item of expense. An examination of the cost data indicates clearly that a substantial saving could be effected by using the chlorate solution, which contains some unconverted salt, directly from the electrolytic cells. This would eliminate evaporation, processing, drying, and packaging costs. Such chlorate liquor, modified by the addition of calcium chloride or calcium hydrate, is suitable for the treatment of weeds on railroad rights-of-way and is transported by special cars for this purpose. For agricultural purposes, however, the presence of unconverted salt and the hazards and cost of transportation have hitherto constituted insurmountable objections to the use of chlorate cell liquor.

The items which enter into capital investment are set forth in Table VII. The cost of equipment has been obtained from reliable sources and, in many instances, the estimates or bids are in our files. The cost of construction has been obtained largely from advices of electrochemical organizations and engineering companies. The rates of depreciation are either closely in accordance with general practice or are based on our investigations.

The housing for the electrochemical cells calls for a building approximately 60 ft. wide, 20 ft. high and 350 ft. long. Such a structure, made of steel, with concrete floors and foundations, and having corrugated iron sides and steel deck roof, should cost close to $45,000. The building for processing and drying need not be large, but should preferably be a three-story, reinforced-concrete structure so as to permit gravity flow of materials in process. A suitable housing should cost about $30,000.

The cost of the 2,500 kw. synchronous converter, including 3-phase transformer, starting panel and high-tension switching gear, will be close to $65,000 installed. Estimates ranging from $22 to $27 per kw. are available and a figure of $26 is used here. The housing for the converter, including air washing equipment, will be approximately $8,000. Distributing panels and electrical equipment for each series of cells are estimated at $1,000, or $10,000 for the ten circuits. Stepdown transformers, transmission lines, and accessories enabling use of bus bar power will entail an additional expenditure of $10,000 for auxiliary electrical equipment.

Based on our experience, the material and assembly



Chlorate cells were fabricated from ¼ in. black iron plate and were 33 in. inside diameter

Table VII. Capital Investment and Depreciation

(Based on an annual production of 6,000,000 lb. of sodium chlorate)

	Cost	Depreciation Rate (%)	Annual Depreciation
Building for cells	$45,000	5	$2,250
Building for processing	30,000	5	1,500
Synchronous converter and transformer, 2500 kw. @ 280 volts	65,000	8	5,200
Housing for converter	8,000	5	400
Auxiliary electrical equipment	20,000	8	1,600
Electrochemical cells, 800 @ $135 complete	108,000	8	8,640
Outside cooling coils for electrolyte, 160 wanted	5,000	10	500
Settling tanks (3)	8,000	10	800
Sand filter	1,000	10	100
Evaporator with salt baskets or filter	20,000	10	2,000
Crystallizers, continuous	5,000	10	500
Centrifugals (2)	5,000	8	400
Dryer	5,000	8	400
Administration and laboratory buildings	25,000	5	1,250
Plant facilities (warehouses, water mains, sewers, roads, etc.)	35,000	5	1,750
Fixtures, tools, etc.	16,000	10	1,600
Contingencies	19,000	5	950
Annual depreciation charge			$29,840
Idle plant expense			2,500
Total			$32,340

Depreciation and obsolescence per lb. chlorate, 0.54c.

Investment in plant	$420,000
Investment in real estate	50,000
Investment in chemical stocks	80,000
Investment in storeroom stocks	20,000
Total investment	$570,000

cost per cell should not exceed $135, or $108,000 for the 800 cells. This is equivalent to an outlay of $43.20 per kw. of converter rating.

For technical operations, the control of electrolyte temperature would, preferably, be accomplished by outside cooling coils rather than by the use of a submerged coil as shown on the blueprint included in this report. The cell liquor would pass through the coils and thus obviate corrosion problems incidental to exposure of iron at the liquid-vapor line. About 160 coils should prove sufficient for the 800 cells, and the cost would be in the neighborhood of $5,000.

The demand for chlorate is seasonal and, consequently, large stocks must be accumulated during the winter months. The quantity of such stocks may reach 2,000,000 lb. of unpacked material, which, along with salt stocks and cell liquors, will have a process value of $80,000. Another $20,000 is tied up in containers, supplies, repair materials, chemicals, etc.

Table VIII. Overhead, Depreciation, and General Annual Expense

	Cost	Cents Per pound Chlorate
A: *Summary*: Annual Charges		
Management	$20,000	0.33
Insurance	5,000	0.08
Taxes, real estate	3,000	0.05
Depreciation (see Table VI)	32,340	0.54
Interest on investment, $570,000 @ 5 per cent	28,500	0.48
Total overhead expense	$88,840	1.48

B: *Management Details*		
Manager	$10,000	per annum
Secretary-accountant	3,000	
Stenographer	2,000	
Clerical	2,000	
Other office help	3,000	
Total	$20,000	per annum

C: *Insurance Details*	
Plant insurance @ $2 per $1,000 for $200,000	$400
Employment insurance, 3% of payroll, $90,000	2,700
Compensation and first aid	1,900
Total	$5,000

Table IX. Summary of Sodium Chlorate Costs

Based on annual production of 6,000,000 lb.

Direct Charges

	Cents Per pound		Per cent of total
Materials and electric power	1.23		25.10
Factory operating expense	1.32		26.94
Auxiliary power	0.26		5.31
Anode replacement	0.25		5.10
Packaging	0.36		7.35
Total prime cost		3.42	
Overhead			
Management	0.33		
Insurance and taxes	0.13		
Depreciation and obsolescence	0.54		
Interest charges	0.48		30.20
Total overhead		1.48	
Total estimated cost per pound sodium chlorate		4.90	100.00

Notes: This excludes sales and promotion expense and corporation taxes; but including 5 per cent interest on investment. No credit is taken here for byproduct hydrogen gas, the sale of which in some localities may effect a reduction of 0.2c. in cost of chlorate.

The estimated cost is necessarily based on experimental evidence and assumptions which are set forth in the technical section of this report. It is to be expected that the cost items may vary slightly in different localities according to the unit price for power, labor, and materials.

A summary of the items comprising general overhead is given in Table VIII. Obviously, such items as taxes and insurance will vary widely with local circumstances, but the estimates given are fair averages for industrial establishments.

The condensed cost sheet is given in Table IX.

It is not amiss to recall that the spread between plant cost of 4.90c. and base selling price of 6.25c. is not clear profit. Sales, advertising, and promotion expense are important charges in any going concern. State and federal corporation taxes, likewise, gnaw away a substantial part of the gross net income. The extent of these burdens is difficult to evaluate. A brief reference to these items is, nevertheless, desirable to indicate definitely that no appreciable reduction in price will occur by modifying these charges.

No definite information is available to us with respect to the domestic distribution of sodium chlorate. It is reasonable to assume, however, that the 6,000,000 lb. produced annually may be marketed as follows:

2,000,000 lb. @ 6¼¢ =	$125,000	
2,000,000 lb. @ 6¾¢ =	135,000	
2,000,000 lb. @ 7¼¢ =	145,000	
The gross sales value will be	$405,000	
Less 10 per cent for sales and promotion	40,500	
Net sales value		$364,500
Estimated factory cost, 6,000,000 lb. @ 4.90¢		294,000
Net income		$70,500
Less corporation taxes		
Federal, $9,415.00		
Est. State, $3,525.00		12,940
Estimated profit		$57,560

It is apparent, therefore, that the estimated profit of $57,560 on 6,000,000 lb. production is not quite 1c. per lb., and is equivalent to almost exactly 10 per cent on the estimated investment of $570,000, after interest charges are paid.

As a result of our investigations, it is concluded that 4.90c. per lb. constitutes a reasonable cost of production. It has been shown that this enterprise is seasonal and is confronted with both industrial and economic hazards of appreciable magnitude, thus justifying compensatory returns on investment.

Based on an annual production of 6,000,000 lb. an estimated net profit of $57,560 will be realized, provided the total output is sold and no manufacturing or economic disturbances occur. This potential profit is equivalent to a return of 10 per cent over and above interest charges on the estimated investment of $570,000, and is slightly less than 1c. per lb. profit. It is not for us to say whether this constitutes too great or too small a return in an enterprise of this character.

The need of sodium chlorate for agricultural purposes is apparent. To get the best results from this or other herbicides, a concerted and widespread attack on weeds must be made. Due to ex-factory charges, the farmer must pay about 9 to 10c. per lb. for the chlorate. With an application of 165 lb. per acre, this entails an expense of $14.85 to $16.50 per acre. To many farmers this is admittedly a burden, but it must be recognized that the producer of chlorate is not alone to blame for this situation. Transportation and distribution charges and governmental taxes constitute a large percentage of the selling price. Assuming that the manufacturers' profits were completely eliminated, the cost of chlorate under present distribution systems would still be considered too high by most farmers.

Plant of Shawinigan Chemicals, Ltd., at Shawinigan Falls, Quebec, for the production of synthetic chemicals from acetylene

Recent Developments in CANADIAN CHEMICAL INDUSTRIES

By F. G. GREEN, W. H. DEBLOIS and G. S. WHITBY

Respectively, NATIONAL RESEARCH COUNCIL OF CANADA; Production Manager, Acid Dept., CANADIAN INDUSTRIES, LTD.; NATIONAL RESEARCH COUNCIL OF CANADA

CANADA has made notable progress in building up her chemical industries, particularly those branches which have a solid foundation in the Dominion's natural resources of raw materials and energy. This advance is all the more significant in that it has been made in the face of unfavorable conditions—a relatively small and scattered domestic market, high cost of building, equipment and plant supplies, absence of fuel production in the highly industrialized areas, and extremes of climatic conditions.

Canada came into prominence as an oil producer almost simultaneously with the United States, but today only about 3 per cent of the domestic requirements are produced in that country. Canada's chief contribution to the petroleum industry in recent years has been the development of the phenol process for the treatment of lubricating oils. This process was first publicly described in 1933, but for three years prior to that time, oils treated at Sarnia with phenol by Imperial Oil Limited, had been marketed in Canada.

Another Canadian contribution to petroleum refining is the use of a tower in which the ascending vapors of cracked gasoline meet a descending slurry of finely ground clay. It has been found that the overhead gasoline from these towers will retain its color and resist oxidation for an extended period. Since there are isolated districts in Canada where gasoline supplies are stored for eight months or longer, the values of these properties are self-evident.

Of outstanding interest to chemical engineers in Western Canada are the large and expanding chemical and metallurgical activities at Trail, B. C. Huge plants have been built there with a daily capacity of 475 tons of lead, 400 tons of zinc, 60 tons of copper, 25,000 oz. of silver, accompanying gold, antimony, bismuth and cadmium, and 475 tons of concentrated phosphatic and nitrogenous fertilizers. More than 225,000 hp. of hydroelectric power have been installed in connection with the Trail enterprises. The most recent and significant development is the recovery of elemental sulphur from smelter stack gases,—a process of peculiar importance to Canada.

Oldest and largest of the Canadian chemical industries is the manufacture of pulp and paper, which in recent years has proved the country's largest employer of chemists and chemical engineers. Soda pulp was first made 60 years ago followed by sulphite pulp in the early eighties and sulphate in 1907. Among many recent developments of chemical engineering interest are those having to do with the technique of pulp bleaching which has undergone radical changes in a process developed and intro-

Based on a paper presented before the Toronto meeting of the American Institute of Chemical Engineers, May 26, 1937.

At Trail, B. C., 475 tons of concentrated phosphatic and nitrogenous fertilizers are made daily. A recent development is the recovery of elemental sulphur from smelter stack gases

duced in Canada by Thorpe and Tomlinson, the pulp is first treated with chlorine before bleaching with hypochlorite. By this means the ligneous impurities are rendered water soluble by chlorination and considerable economies are effected in the amount of the bleach liquor and the time required to complete the bleaching process.

Important developments in alkali recovery in the pulp and paper industry are largely associated with the name of G. H. Tomlinson.

The recovery of byproducts from chemical pulp manufacture has received attention but economic factors have not generally favored large-scale development. Spruce turpentine (cymene) has been recovered at one kraft mill for about ten years and recently baker's yeast has been produced from waste sulphite liquor by a process developed in Finland. The formation of vanillin by the action of hot alkalis on waste sulphite liquor has been studied by Tomlinson 2nd and Hibbert at McGill, and yields as high as 7.3 per cent calculated on the weight of lignin or 2 per cent calculated on the weight of the spruce meal were obtained. In Cornwall, Ont., a plant for the production of vanillin from waste sulphite liquor started production in April.

A sulphuric acid plant erected near Sudbury in 1925 is believed to be the first contact plant to employ smelter gases. In 1930 a similar and larger plant was built at Copper Cliff, Ont., using gas from a nearby smelter. Much preliminary investigation was necessary since these gases have characteristics different from those of ordinary pyrites or burner gases. Furthermore, it was essential that acid manufacture should not interfere with normal smelting operations. The blast furnace gas was not suitable without radical alteration in the design of the furnace, but gas from the converters, containing 14 per cent SO_2 was collected with a minimum of dilution, passed through electrostatic precipitators of the pipe type to remove catalyst poisons, such as arsenic, antimony, selenium and tellurium and finally used in the process. The average content of arsenic in the purified gases is only 0.00004 mg. per cu.ft.

More recently a plant with novel features for the production of liquid sulphur dioxide has been built at Hamilton, Ont. The most novel feature of the design is the heat exchanger of finned-tube construction. The method of compression and refrigeration was adopted and high efficiency attained by the use of high pressure during liquefaction. At pressures of 20 atm. and liquefaction temperatures of —65 deg. C., very little sulphur dioxide remains in the gas in equilibrium with the liquid sulphur dioxide.

At Copper Cliff a plant was erected in 1930 to produce the sodium bisulphate used in the Orford process for separating nickel and copper. This is the first plant built for the production of nitre cake as a direct product. It consists of nine units,—feeder, mixer, oil-fired retort and cooling conveyor—each of 25 tons daily capacity.

Only in recent years has any serious exploitation been attempted of the 120,000,000 tons or more of sodium sulphate found in dried-up lakes in Western Canada; but there are now several plants in Saskatchewan engaged in dehydrating the salt and supplying the needs of the kraft pulp mills as well as the requirements of the Copper Cliff niter cake plant.

The production of sodium sulphide of 90 to 95 per cent purity by fusion of sodium sulphate and carbon in an electric furnace was perfected by Freeman and put into operation at Shawinigan Falls in 1924. Competition from abroad caused cessation of operations, however, although the soundness of the process was conclusively demonstrated in actual commercial operation.

The manufacture of synthetic anhydrous ammonia was undertaken in Canada by Canadian Industries, Ltd., in June, 1930. The Calsale process is used, utilizing the byproduct hydrogen from electrolytic alkali-chlorine manufacture. A portion of this hydrogen is burned in air to supply the nitrogen requirements. The total output is used within the company for nitric acid and ammonium-nitrate manufacture. A large synthetic ammonia plant is operated in connection with the fertilizer plant at Trail.

In 1932 Canadian Industries, Ltd., built a plant at Windsor to manufacture sulphur dichloride used chiefly in the acetate rayon industry. In 1934 the manufacture of ferric chloride was also begun. Practically the total output from this plant is used in sewage treatment.

The manufacture of phosphoric acid by oxidation of phosphorus was started at Buckingham, Que., by the Electric Reduction Co., Ltd. in 1924. This company had been producing phosphorus by the electro-thermic smelting of phosphate rock since 1897, but principally for the export market. Using this pure phosphoric acid as primary material, a plant was built in 1932 for making acid phosphate of lime which is used as the principal ingredient in baking powders and is now supplying the major part of Canadian requirements. The production of trisodium and disodium phosphate followed in 1934. In 1933 the same company resumed the manufacture of sodium chlorate which in recent years has found extensive use as a weed killer and in addition to supplying Canadian requirements, is exporting this material to Empire countries.

The plants of Canadian Industries, Ltd. at Hamilton and Beloeil, Que., utilize the Ober system for reacting phosphate rock with sulphuric acid under pressure. The reaction takes place in an autoclave into which the acid and finely ground rock are injected. The autoclave is revolved for about half an hour and the charge dumped and elevated to storage. The advantages are a much reduced curing time, lower moisture content and an improved physical condition of the superphosphate.

Canadian industry was one of the pioneers in synthetic organic chemistry. A war-time development in this field, interesting because of the relatively short time required for transition from laboratory to full-time production, was a manufacture at Shawinigan Falls of glacial acetic acid and acetone from acetylene gas. Only 14 months elapsed between the initiation of laboratory research and the full-capacity operation of a plant costing $2,000,000 and covering 15 acres. Later when a duplicate plant was erected for the United States government, only minor variations in the original design being found necessary.

In recent years a number of additional products derived from acetylene are being prepared at this plant. Among these are acetylene black used in dry batteries and for thermal insulation, ethyl acetate produced by the catalytic condensation of acetaldehyde, vinyl acetate from acetylene and acetic acid and a variety of synthetic resins produced by polymerization of vinyl acetate alone and in conjunction with acetaldehyde and formaldehyde. The vinyl acetate production grew out of the ethylidene diacetate production started to furnish the acetic anhydride demanded by cellulose acetate manufactures. In a continuous process practically all of the acetic acid is converted to vinyl acetate or ethylidene diacetate.

Another development of interest is the process announced about 15 months ago for the direct manufacture of acetic anhydride by the oxidation of acetaldehyde. Still more recently there has been placed in operation a single-stage process for the production of acetone from acetylene and steam in the presence of a catalyst. In November, 1936, Canadian Industries, Ltd. began operating a plant at Shawinigan Falls for the manufacture of perchlorethylene and trichlorethylene. The latter is made from acetylene which is piped over from the plant of Shawinigan Chemicals, Ltd. and the chlorine is brought in by tank-car from Cornwall.

As a result of intensive research a rather wide range of refractories are being made from Canadian magnesitic dolomite. Among recent developments are a magnesian-chrome brick of outstanding refractoriness and spalling resistance, a quick-setting refractory clinker resistant to hydration, and an unburned, chemically bonded brick for general use at high temperatures in which a new bonding agent is used.

Based on research carried out by Thorvaldson at the University of Saskatchewan, there is now being manufactured a special type of Portland cement resistant to the "alkali" (sodium and magnesium sulphates) soils which occur widely in Western Canada.

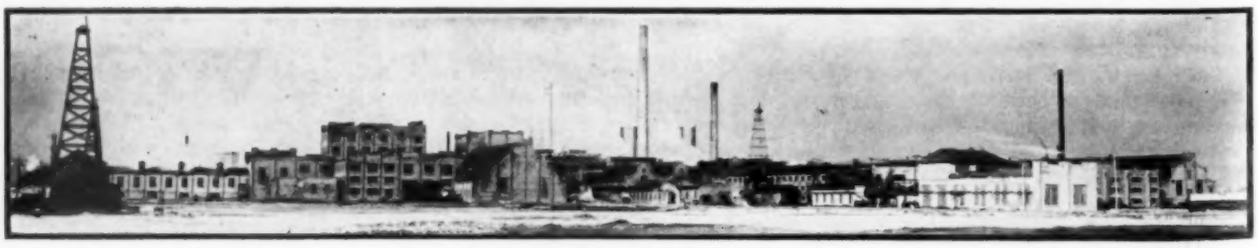
Selenium, a byproduct in refining the copper from certain mines, is being recovered. Recovery was started in 1931, and the output has grown so rapidly that Canada is now the leading producer of the element.

Rayon manufacture has been carried on in Canada for slightly more than ten years. This rayon is made at Cornwall, Ont., and acetate rayon at Drummondville, Que. At Cornwall approximately 5,000 tons of sulphite pulp were required for the 1936 production calculated on the basis of 1.3 lb. of wood pulp per lb. of viscose. To fulfill plant requirements for caustic soda, a plant has been erected in Cornwall and quite recently the company has introduced a caustic recovery process.

The Canadian textile industry as a whole consumes approximately $8,000,000 worth of chemicals, dyestuffs, soaps and oils according to a 1935 estimate. The increasing demand for hydrogen peroxide as a bleaching agent was responsible for initiating the manufacture of this material at Shawinigan Falls in April, 1935. The Laporte process is used under special arrangement.

Obviously these are but a few of many chemical engineering developments in Canada which it has been possible to present only in the barest outline. For those interested in having more specific information, complete bibliographies may be obtained from the National Research Council in Ottawa. It is significant, however, that within the past decade, those following the professions of chemistry and chemical engineering have increased in Canada more than any professional class—certainly a favorable omen for the future of Canadian industries.

Salt, chlorine and caustic soda plants of Canadian Industries, Ltd., Windsor, Ontario



Flash Roasting of Pyrites Concentrates in SULPHITE PULP MANUFACTURE

After several years of commercial operation of the flash roasting process for pyrites concentrates, developed by the author in the period since 1927, sufficient data are available to permit reporting the successful results that have been attained in an installation handling up to 24 tons of concentrates per day. The plant described is making sulphur dioxide gas for use in cooking acid for sulphite pulp manufacture. Earlier results were reported to the A.I.Ch.E. in June, 1931, and summarized in *Chem. & Met.* for that year and month.

By HORACE FREEMAN

TECHNICAL DIRECTOR
CONSOLIDATED PAPER CORP., LTD.
THREE RIVERS, P. Q., CANADA

FLASH ROASTING of pyrites concentrates for the production of sulphite cooking acid was first reported on a commercial scale in 1929 at the St. Maurice Valley Paper Mill at Cap-de-la-Madeleine, P. Q. An improved installation was erected at St. Lawrence Paper Mills, Three Rivers, P. Q., in 1932. Prior to this time, a great expansion had taken place in the newsprint industry in Canada. Naturally, during such a period of expansion, the full attention of operators was drawn to the pressing matters of production and the search for refinements in technique was not so intensive as it is today. Sulphur for the sulphite process was available as brimstone, it was readily utilized, and inefficiency in its use was not a matter of much moment; consequently the installations in Canadian paper mills erected during the growth period followed the general design of rotary burners and lead pipe coolers. The introduction of the much cheaper form of sulphur in pyrites flotation concentrates involved overcoming objections against the erratic supplies, variable quality and inefficient methods of using run-of-mine pyrites that were in vogue prior to the development of nearly pure brimstone in the Southern States.

The incentive to introduce the use of pyrites in Canada was provided by a great expansion of base metal mining in this country during the past quarter century, combined with the use of the flotation method of concentrating ores containing pyrites. Ample quantities of pyrites flotation concentrates in the form of a finely ground product consistently containing 50 per cent of sulphur are now available in Canada.

In considering the introduction and use of this new form of pyrites, it was early seen that full consideration would have to be paid to efficiency of conversion of the pyrites sulphur to sulphite acid. The deficiency of the process using brimstone first was investigated. It was found that with a rotary burner operating under normal conditions in a typical plant using lead pipe coolers externally cooled with water, and Jenssen absorber towers with limestone filling, the efficiency from sulphur in brimstone to sulphur in acid made averaged 88 per cent.

The losses involved were due to a number of causes, chief of which was the formation of sulphur trioxide in the burner gas. More frequently than not, the gas left the burner at temperatures below 1,000 deg. C. and then passed through cast iron pipes of considerable length and exposed to the air, before entering the lead cooler, thus dropping slowly to about 400 deg. C. on its way. This temperature range is favorable to the formation of trioxide. A small part of the trioxide condensed with moisture in the lead cooler and the bulk of the remainder passed through the absorbing tower without being absorbed by the water.

Studies of the rotary burner also showed that when attempts were made to produce a strong gas, sublimation of unburnt sulphur often occurred and this condensed in and blocked the lead cooler. This sublimation of sulphur emphasized the poor mixing of the gases (sulphur and air) in the combustion chamber following the rotary.

Now in considering the use of pyrites, it was predetermined that combustion temperatures of 1,000 deg. C. would have to be maintained, and as the gas would carry considerable iron oxide dust, the catalytic oxidation of the SO_2 would have to be avoided by cooling rapidly to below 400 deg. C. It was obvious that lead coolers would be unsuitable, or if used, would have to be preceded by other means for cooling from the high temperature and for removing the dust.

In considering the ordinary water scrubber or wash tower for rapidly cooling the gases, it was found that

Presented on May 26, 1937, at the Toronto, Canada, meeting of the American Institute of Chemical Engineers, under the title of: "The Use of Pyrites Concentrates in Sulphite Pulp Manufacture."

the quantity of heat to be removed from the gases justified the use of a steam generator as a precooler, partly because of the high initial temperature and because of the value of the steam that could be produced. Examination of the reaction between pyrites and air showed that temperatures higher than 1,000 deg. C. would be developed. The use of moving parts in the combustion zone was therefore to be avoided.

Early Flash Roasting Experiments

The author's first attempts at space roasting of sulphide ores were made in Shawinigan Falls, Canada, in 1927, in a horizontal chamber which was heated by a high voltage electric arc, extended into the furnace by a blast of air. Zinc sulphide concentrates were injected by the same blast of air and a high roasting rate was developed. It was, of course, soon found that the heat of the electric arc was not necessary to support combustion. The possibility of commercially roasting sulphide ores in space soon developed and the first space roaster using pyrites consisted of (1) a means for blowing a mixture of pyrites and air into (2) a vertical cylindrical combustion chamber on which (3) a vertical fire-tube boiler was superimposed, and (4) a vertical cylindrical wash tower to cool the gases from the boiler.

These experiments came to the attention of several metallurgical companies and considerable commercial development has resulted.

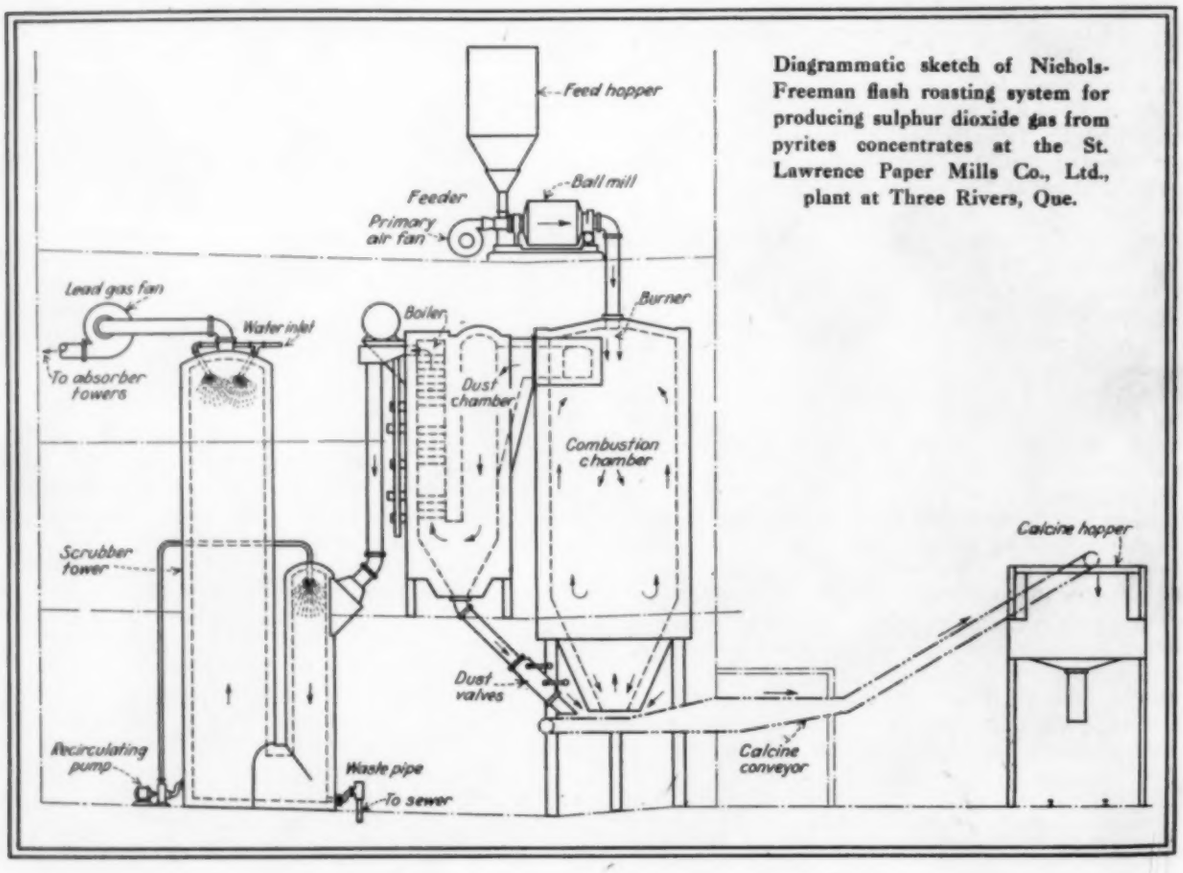
The experimental arrangement for pyrites, operated at Shawinigan Falls in 1927, was not attached to a sulphite mill but its operation sufficed to demonstrate the advantages of the procedure. It was succeeded by the operating installation at St. Maurice Mill and this in turn by the installation at St. Lawrence Mill.

It is now possible after several years of continuous operation to record the performance of an installation using up to 24 tons of pyrites daily in the manufacture of sulphite pulp.

It has been found that the concentrates are best handled from the mine in hopper bottom cars. The moisture content should not exceed 2 per cent or freezing in cars will occur. Also the material will tend to hang up in the feed hopper on the unit even if it is not frozen. The drying of the pyrites at the mine is best accomplished with flue gases in a rotary dryer with concurrent flow of gases and pyrites. The initial temperature of the gases may be extremely high and their volume small so that dust loss in the discharge is negligible.

The improved St. Lawrence installation is shown in the accompanying diagrammatic sketch. The rate of feed from the hopper to the unit is controlled by a star feeder regulated by an adjustable ratchet. A satisfactory control is obtained. The pyrites is drawn with air into the ball mill, the purpose of which is to break up aggregates and bring the material into suspension in the air. A light charge of balls is used.

Airflow through the mill is provided by a variable-speed, motor-driven fan which blows the mixture through the nozzle into the combustion chamber, which is cylindrical, lined with firebrick, backed with Sil-O-Cel brick and cased with steel. Two outlets for the gases are provided at the top periphery of the chamber to convey them into the steam generator or cooler. The flame from



Diagrammatic sketch of Nichols-Freeman flash roasting system for producing sulphur dioxide gas from pyrites concentrates at the St. Lawrence Paper Mills Co., Ltd., plant at Three Rivers, Que.

the nozzle flows downward through the center of the chamber, reverses just above the hopper bottom and flows upward between the center and sides. The major portion of the cinder falls into the hopper bottom and thence onto a pan conveyor.

It is here proper to refer to conditions in the combustion chamber, particularly in regard to slagging of the iron oxide with the refractory lining, since previous attempts at space roasting have encountered this difficulty and some unnecessarily complicated furnace structures have been designed and patented as a result. Slagging and building of large accretions on the walls are due to the imperfect removal of sulphur, which may result from insufficient air, improper mixing and more often from insufficient combustion space and faulty burner design. Our development in this respect has paralleled the combustion of powdered coal. Under the conditions, which obtain in the St. Lawrence unit, slagging is never encountered.

It is desirable that combustion chamber temperatures be maintained at about 1,100 deg. C. The temperature will rise considerably higher than this under normal operating conditions and we find it of great advantage to recirculate part of the cooled gas leaving the boiler and return it through the ball mill into the burner nozzle. Thus, heat is removed from the combustion zone and high gas strength is maintained. As a means of checking temperature, a recording pyrometer is employed in the second pass of boiler tubes where the temperature is not high enough to damage the pyrometer. The temperature at this point, 1,400 to 1,500 deg. F., serves to indicate the condition in the combustion chamber and by it the quantity of recirculated gas is regulated to keep the temperature within desired limits.

The gases, averaging 11 per cent SO_2, enter the boiler at 1,000 deg. C. and are cooled to 350 deg. C. Experience has shown that where the unit must be shut down during week ends, or for longer periods, there is danger of corrosion of steel boiler tubes. In the design finally adopted, the boiler tubes are encased in finned cast iron sleeves, which also serve to increase the cooling surface. Three years of operation for six days per week has shown this design to be justified. The boiler tubes are cleaned with a hand air lance once a shift and the dust falls down a chute onto the same conveyor that removes the sinter from the bottom of the combustion chamber. A motor driven steel pan roller conveyor has been used during the period but a vibrating trough conveyor would be preferable in future installations.

Treatment of the Gases

The gases leaving the boiler are conducted through mild steel ducts, not lined but externally heat insulated, to the cooling and washing tower. The same steel ducts have been in use for four years without signs of corrosion.

The gases are now cooled in a double tower system. In the first and smaller tower the wash water is recirculated by a Duriron pump. The purpose of the recirculation is to provide a more thorough cleaning of the gas and to insure that the discharge water is at the highest possible temperature to avoid loss of dissolved SO_2. The incoming fresh cold water is supplied at the top of the larger tower and the gases are cooled by countercurrent flow. Spiral tile packing is used in both towers. The cooled and saturated gases are exhausted by a variable speed fan and, by it, are forced into the usual limestone absorption towers.

No difference in quality of sulphite pulp produced by pyrites as compared with sulphur has been detected and no change in the cooking procedure has been required. The pyrites system is linked up with the chemi-pulp hot acid system. The sulphite pulp is used in the manufacture of newsprint. The quality of the acid produced is quite suitable for high grade bleached sulphite. It should be noted that the greater part of the high grade sulphites produced in Europe are made with pyrites systems.

The unit has been in operation for five years. During the first two years the operation was much interrupted by spasmodic sulphite pulp demands. The steel boiler tubes suffered corrosion owing to the condensation of acid during long and frequent shutdowns. The cast iron covered tubes, however, have been in operation for three years with regular shutdowns week ends and no signs of corrosion have appeared. The furnace lining seems to be quite intact and will probably be good for many years.

A typical analysis of the pyrites used is as follows:

	Per cent
S	50.0
Fe	44.0
Cu	0.3
SiO_2	2.0
Pb	0.003
Zn	0.20
As	0.08
Se	Trace
P	None

And a typical cinder analysis:

	Per cent
Fe	65.0
SiO_2	2.5
Al_2O_3	1.75
S	0.5

The arsenic in gases entering the scrubber has been found to be 0.52 mg. per cubic foot and in the gases leaving the scrubber, 0.022 mg. per cubic foot.

The sulphuric acid in gases leaving the scrubber has been found at 41.3 mg. per cubic foot.

The sulphur loss in the exit scrubber water is between 200 and 400 lb. per 24 hours, being from 0.9 to 1.8 per cent of the total sulphur input.

The unit has operated for long periods at efficiencies of conversion of sulphur in pyrites to sulphur in acid available for cooking of over 94 per cent.

Approximately 25,000 short tons of pyrites has been consumed in the unit. During the month of March, 1937, 966,000 lb. of pyrites was consumed and 1,354,200 lb. of steam (from and at 212 deg. F.) was produced. The steam value covers the cost of operating the burner and of the acid making operation. The capacity of the unit is 120 tons of sulphite pulp daily.

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Radium and Insulin Recovery Featured at Toronto Meeting of A.I.Ch.E.

EDITORIAL STAFF REPORT

RETURNING to Canada after a ten-year absence, the American Institute of Chemical Engineers met in Toronto, May 26–28 for their twenty-ninth semi-annual meeting. A local committee, under the honorary chairmanship of Professor J. Watson Bain of the University of Toronto and actively directed by Dr. Albert E. R. Westman of the Ontario Research Foundation, provided pleasant arrangements for more than 250 members and guests. An evening of unique entertainment centered around an interesting play presented by an amateur group in the theatre of Hart House on the Toronto campus, followed by an exhibition swimming meet featuring the famous Olympic team of "Dolphinettes." Coached by a chemical engineer, these young ladies gave some very illuminating demonstrations of the difference between stream-line and turbulent flow.

Most industrial interest was aroused by two excellent papers on radium recovery and insulin manufacture, both of which were followed by plant visits to witness the processes in actual operation.

Radium is extracted from concentrated pitchblende ores which are shipped 4,000 miles by air, rail and water from the mines at Great Bear Lake to the refinery at Port Hope, Ont. In 1936 this plant treated about 150 tons of these concentrates, containing in addition to about 150 mg. of radium, some 1550 ounces of silver per ton, as well as considerable amounts of uranium, cobalt and bismuth. The rather complicated refining process is composed of four different operations, viz., (1) the preparation of the minerals by roasting and milling, (2) recovery of silver and reduction of the radium into radium-barium sulphate, (3) fractional crystallization to separate the barium and radium salts in the laboratory, and (4) concentration and refining of the uranium salts. The present output of the refinery at Port Hope is approximately two grams of radium element per month, worth at current prices, about $50,000 to $60,000. Ground is now being broken for an addition to the plant which is expected to treble the present output.

The opening technical session on applied chemical engineering started with a discussion of the heavy leather industry by E. H. Smith, Beardmore & Co., Octon, Ontario. The first problem in tanning is to hydrate the collagen and wet back the fiber which raises the water content of the hide to about 65 per cent. Vegetable tanning is carried out in a countercurrent system. The controlling factor in the process is the chemical composition of the "tail rocker" for it is here that the fundamental character of the leather is established. The correct type of tail liquor is developed by time, passing a large number of hides through the stronger head liquors, and the proper choice of tanning materials.

Pretanning with formaldehyde to shorten the time of tanning is not recommended because the strong liquors cannot be exhausted without a rocker section. Drum tanning accelerates the combination of tannin with hide but is liable to damage the leather. Better results are obtained by suspending the hides and simultaneously circulating and warming the liquors. The average consumption of water amounts to approximately 30 lb. per lb. of hide. Spent tan may be precipitated by settling with waste lime liquors. In addition effluent may be treated with ferrous and aluminum sulphate before passing to municipal sewage plant. Where tanneries are located away from such plants and land is available, land treatment may be used, the effluent being filtered by passing over fields and thence to settling basins and the nearest stream.

Canadian Chemical Developments

The recent developments in the chemical industry in Canada were discussed by W. H. De Blois, Canadian Industries, Ltd., and G. S. Whitby and F. G. Green of National Research Council, Ottawa. Their paper will appear on pages 308–310 of this issue of *Chem. & Met.*

The extraction of radium from ores at Port Hope was the subject of a paper by M. Pochon, Eldorado Gold Mines, Ltd., Port Hope, Ontario. This will be published in these pages next month.

The use of pyrites concentrates in sulphite pulp production was covered by Horace Freeman, Consolidated Paper Co., Three Rivers, P. Q. His paper appears on pages 311-313 of this number of *Chem. & Met.*

The production of insulin was discussed by D. A. Scott of the Connaught Laboratories, University of Toronto, at the session on applied and principles of chemical engineering. The raw material is fresh ox pancreas. The glands are first minced and then extracted with ethyl alcohol acidified with hydrochloric acid, the extract is made alkaline with ammonium hydroxide and filtered. The filtrate is acidified with sulphuric acid and the alcohol removed by vacuum. The concentrated extract is then filtered and the protein precipitated with sodium chloride. The anti-diabetic principle which is contained in the precipitate is further purified by isoelectric precipitations and fractionation with 80 per cent ethyl alcohol. The purified insulin is dissolved in isotonic acid water and sterilized by means of a clarifying filter. The potency

of the insulin is determined by means of rabbits and mice. The bulk insulin is diluted to the desired strength, e.g. 10, 20, 40, 80 or 100 units per c.c., and resterilized. It is poured into hard glass vials using aseptic technique, and then stored in a refrigerator until ready for packaging.

In their paper dealing with the drying of a granular solid N. H. Ceaglske, University of Wisconsin, and O. A. Hougen, Armour Institute of Technology, demonstrated that the rate of drying of a granular substance is determined not by diffusion but by capillary forces. The moisture distribution can not be calculated from diffusion equations but depends entirely upon the complex suction-water concentration relationship of the substance. This relationship is dependent upon particle size, degree of packing, and distribution of pore spaces, and hence must be determined by experimental methods.

In the drying of a granular solid the water flow is determined entirely by capillary forces and hence is independent of moisture concentration, indeed, the flow may be in the direction of increasing concentration. These facts are entirely contrary to the requirements of the diffusion law.

High-Efficiency Fractionating Column

A high-efficiency fractionating column was described by D. F. Stedman of the National Research Council at Ottawa. The column packed with fine mesh gauze screen stamped to form truncated cones and punched to provide vapor outlets gave as many as 18 plates per ft. when sections containing not over 4 to 5 theoretical plates were tested with a mixture of n– and cyclo-hexanes. The operating holdup was low, 4 g. benzene/(ft.)/(sq. in.) at a liquid rate of 30 cc./(min.)/(sq. in.) The capacity was 30 cc. n–heptane/(min.)/(sq. in.), equivalent to a vapor velocity of 0.6 ft./sec. The column capacity was increased at the expense of separating efficiency by changing the pattern of the stamping.

In discussing the efficiency and capacity of a bubble plate fractionating column, E. M. Baker of the University of Michigan and Claude C. Peavy of E. B. Badger & Sons Co., Boston, showed that plate efficiencies as high as 120 per cent result from the concentration gradient across the plate. The entrainment occurring during distillation was measured colorimetrically. For plate spacings of 6 and 12 in. the reduction in efficiency, as the velocity is increased, can be satisfactorily calculated on the basis of the quantity of entrainment. For a plate spacing of 18 in. the efficiency, as calculated from the quantity of entrainment, is too high.

The final paper at this session was the discussion of the design of equipment for fractional batch distillation by Marcel J. P. Bogart of the Lummus Co., New York.

Several papers were included in the program of the session on principles of chemical engineering. The first of these concerned temperature drops and liquid film heat transfer coefficients in vertical tubes by R. M. Boarts, University of Tennessee, W. L. Badger, University of Michigan, and S. J. Meisenburg, Shell Petroleum Corp., Arkansas City, Kansas. The average true temperature drop is equal to the apparent overall temperature drop less the average temperature rise of the liquid in the tubes less the boiling point elevation plus the temperature loss in the circulatory system plus the cooling effect of cold make-up feed.

C. H. Brooks of the Sun Oil Co., Marcus Hook, Pa., and Badger discussed heat transfer coefficients in the boiling section of a long-tube, natural-circulation evaporator. An empirical correlation of overall coefficients of heat transfer in the boiling section of a 2 in. O.D., No. 10 BWG, copper tube, showed that the coefficient is a function of the amount of vapor present, the weight rate of liquid fed to the tube, and the average overall temperature difference between the steam and the liquid. This correlation is applicable only within the ranges of variables used for experimentation and to water, or to materials with similar physical properties.

The mechanism of boiling in an externally heated tube has been found to be exceedingly complicated. Three types of action, froth, slug, and film, have been found but no definite connection between the types of action and the conditions of operation could be developed.

Heat transmission from metal surfaces to boiling liquids were discussed by D. S. Cryder of Pennsylvania State College and A. C. Finalborgo, General Printing Ink Corp., New York.

Boiling was the subject of a paper by two du Pont engineers, Thomas B. Drew and Alfred C. Mueller. With a submerged steam coil they found that at overall steam to liquid temperature differences of 25 to 50 deg. C., the "spheroidal state" develops, the liquid no longer maintains contact with the heating surface, and the heat transfer coefficient decreases for further increase in temperature difference.

The condensation of vapors on a horizontal tube have been investigated by Baker and Mueller. In reporting their results the paper was divided into part 1, dealing with the temperature variation around the perimeter of a tube on condensing pure and mixed vapors and part 2, covering heat transfer coefficients for the condensation of mixed vapors of immiscible liquids.

Condensation on Vertical Tubes

The condensation of steam, heptane and steam-heptane mixtures has been carried out on vertical wrought iron and muntz metal tubes enclosed in a Pyrex jacket. The nature of the condensation has been studied by W. C. Patterson and J. H. Weiland of the Texas Co., S. L. Reeburgh of Gulf Refining Co., R. Z. King of Phillips Petroleum Co., and R. L. Huntington of the University of Oklahoma. The observed individual film coefficients are based on wall temperature measurements. The condensates on the metal tubes were caught in a cup and their temperatures were found to fall about midway between the temperatures of the vapor and the wall of the tube respectively. Through correlation of the data with Colburn's modification of the Nusselt theory making allowance for turbulent films, the observed steam film coefficients were found to be slightly high while those for heptane fell far below the theoretical.

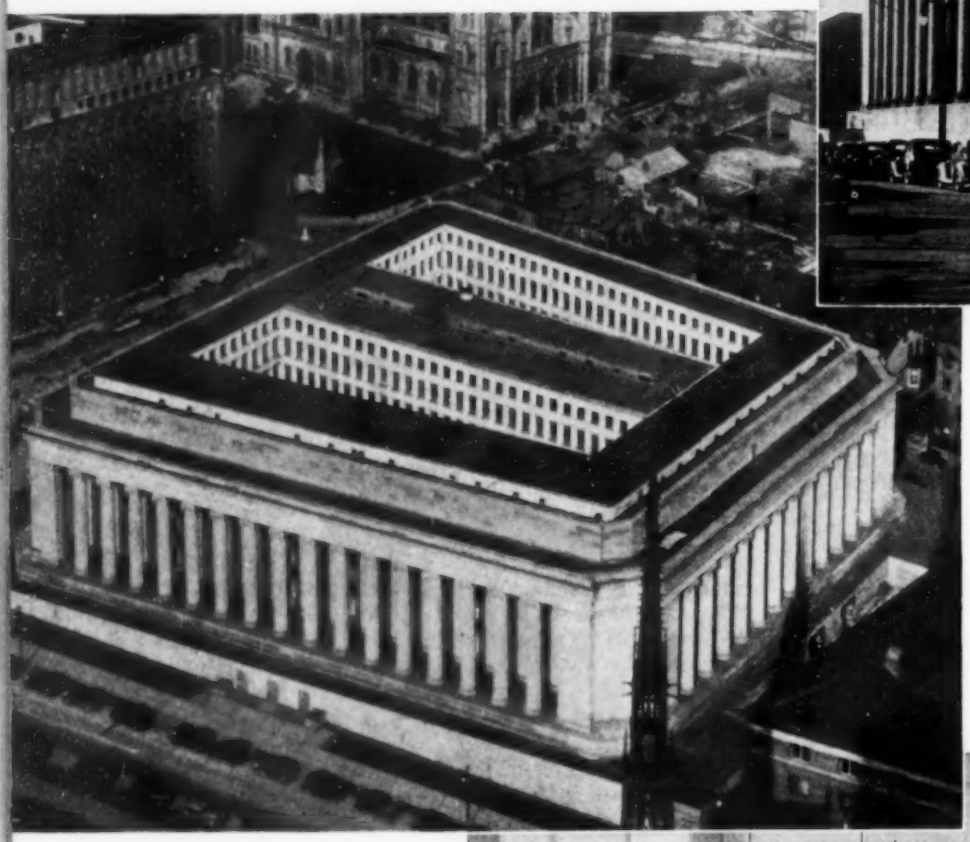
This paper was followed by one dealing with the condensation of mixed vapors by A. P. Colburn and Drew of the du Pont company.

The next paper was presented by D. S. Ullock of Carbide and Carbon Chemicals Corp., and Badger. It was on the subject of liquid film heat-transfer coefficients for condensing Dowtherm A vapors to petroleum and linseed oils in a vertical-tube heater. Badger presented a paper on heat transfer coefficients for condensing Dowtherm films.

An experimental forced circulation evaporator which was made entirely in the shops and assembled in the laboratory of Cornell University was described by Chas. C. Winding of that Institution.

Refractory problems are being studied in one of the many laboratories in Mellon Institute's new home

All the beauty of an ancient Grecian temple is recaptured in this impressive colonnade



Interior courts surfaced with glazed ivory terra cotta allow natural light to reach all laboratories

Right — Typical of the new laboratories is this one devoted to commodity standards research

RESEARCH—

Mellon's Magnificent Obsession

Editorial reflections from a trip through the new building of Mellon Institute in Pittsburgh

By SIDNEY D. KIRKPATRICK

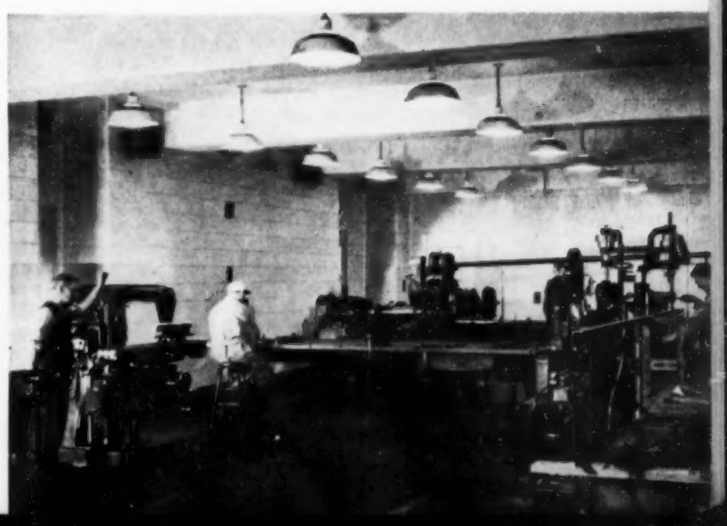
IN THIS STORY the moral must come first: If you have a big idea, bigger perhaps than you can master alone, *write a book about it.* The chances are that somebody will read your book and, if sufficiently impressed, may do something about it. That is how the Mellon Institute of Industrial Research happened to have been founded—according to the simple, dramatic story which some of us heard for the first time from the lips of its beneficent founder, the Hon. Andrew W. Mellon, speaking in Pittsburgh, on May 6, at the formal dedication of the Institute's magnificent new building.

To be sure Prof. Robert Kennedy Duncan, of the chemistry department of the University of Kansas, had no such motive in mind thirty years ago when he wrote "The Chemistry of Commerce." But he did have a big idea—bigger than he ever imagined—namely that industry and science working in harmonious cooperation, could probably do more than anything else to advance the future progress of the United States and the happiness of its citizens. To try out his idea he set up an Industrial Fellowship System as a means of helping manufacturers to employ scientific technology in place of their traditional rule-of-thumb methods.

While all of this was getting started in Kansas, Mr. Mellon and his resourceful brother, the late Richard B. Mellon, were looking for the answers to some industrial problems of their own. One of these they put up to the general manager of the Gulf Oil Company, George H. Taber, who promptly told Mr. Mellon where the answer could be found in a new book that had just appeared—Duncan's "The Chemistry of Commerce." Mr. Mellon became so interested that before he was through he read the book from cover to cover and forthright decided to get acquainted with its author. That acquaintance finally led, in 1910, to the invitation of the Mellon brothers to Dr. Duncan to come to the University of Pittsburgh to serve as its professor of industrial chemistry and director of industrial research. In the following year the first Industrial Fellowships were established in Pittsburgh.

Only a couple of years were necessary to demonstrate that the Duncan principle was a sound one—that the fellowship idea not only benefited the public through scientific accomplishments, but also helped to train young men for useful careers in research. So in 1913 the brothers founded Mellon Institute, dedicating it to their father, Judge Thomas Mellon who had been born just 100 years before. Thus the fellowship plan was established on a permanent basis and by 1915 the Institute had outgrown its original quarters and was forced to move into its own large building on O'Hara Street. Professor Duncan, unfortunately, did not live to see the completion of the new building, but his name and influence have been perpetuated through the Robert Kennedy Duncan Club, the social organization of the Institute's members. Raymond F. Bacon succeeded Professor Duncan as director in 1914 and served until 1921 in that capacity. In its new surroundings and with continued support from its founders, the Institute kept on growing until about six years ago it became evident to the Mellon brothers that a still larger and more commodious plant was necessary if the big idea of Professor Duncan was to be carried still farther by his former student and present successor, Dr. Edward R. Weidlein, president of the American Chemical Society and director of Mellon Institute since 1921.

SO much for history. This article was intended merely to describe the remarkable new facilities of the Institute but for the benefit of those who do not know how the Institute works, a brief account of operations under the fellowship plan may not be out of place. First we start with the research problem brought to the Institute by individual manufacturers, trade associations or other interested groups. If a job is of such a character and scope that it can be handled by the Institute, the investigation is organized and a contract to cover at least a year's operation is made with the proposer who now becomes the "donor" of the fellowship. Then the Institute selects a man or men best fitted for the research and the work is started under the guidance and advice of



the Institute's executive staff. The donor is kept informed of the result of the work, which of course becomes his property although it is usually shared with the public through publication and commercial development.

In addition to these industrial researches, a number of investigations in pure science have been undertaken for the benefit of the professions and the public. These are financed by the Institute itself or by grants from science-minded citizens. Studies of atmospheric pollution, of nutrition and the impressive work in medicine carried out in cooperation with Pittsburgh hospitals—these are pure science "investments" that pay rich dividends in public good.

Since the first fellowships were established in 1911, nearly 4,000 American companies have put their problems up to Mellon Institute. The results are to be seen in hundreds of new products and processes and sometimes in entirely new industries—to say nothing of the contributions to literature represented by 19 books, 143 bulletins, 744 research papers and 1117 miscellaneous articles (not including this one) published in technical journals by Institute personnel. Sixty-four fellowships requiring the services of 177 scientists and engineers were in operation on March 1, 1937. The annual research appropriation by the donors in the fiscal year preceding that date was $816,315. To house such a going and growing business, the founders have now seen fit to spend upwards of $5,000,000 for the finest research facilities that money can buy.

To present, in a few words, an adequate architectural description of this magnificent structure is far beyond this writer's evident limitations. For such information, the reader is referred to the accounts in several of the architectural journals. What follows are merely the lay impressions of an itinerant editor, supplemented by a few facts, efficiently furnished by the dedication staff:

As you approach the new Mellon Institute from across the campus of the U. of Pitt., your first impression is of a great Grecian temple of outstanding beauty and simplicity. Its tremendous size is not immediately apparent, yet as you draw nearer, you soon realize that it occupies practically an entire city block—that on each of its four sides is a great colonnade of majestic columns. In all, there are 62 of these "pillars of science"—the largest monolithic column installation in the world. Each averages six feet in diameter and 36 feet high and weighs almost 60 tons. None of these shafts varies more than ⅛-in. from established measurements and were put in place, we were told, without a single scratch.

But now that our architectural description has been marred by statistics, perhaps we should note that 269 carloads of limestone and 62 carloads of granite went into the construction of the building, not to mention 4,160 tons of terra cotta, 4,200 tons of structural and 932 tons of reinforcing steel. The building is 306 ft. wide at the front, 227 ft. at the rear and has a depth of 334 ft.

As you enter between the impressive pillars, the idea of the Grecian temple persists for the main lobby reflects the same simple, but impressive style, with its gleaming marble walls and ceilings. Carved in the marble above the doorway is a bas-relief, taken from Greek mythology to depict the creation of scientific knowledge and thus to symbolize the research spirit of the Institute. In the marble floor are medallions showing the insignia of the principal scientific and technical societies. Glancing across to the aluminum elevator doors, you note that they are ornamented with familiar alchemical symbols. Gradually you realize that behind this symbolism shines the genius of an old and multi-talented friend, Assistant Director William Allen Hamor.

But perhaps it is the efficient automatic elevator that first brings home the fact that what from the outside looked like a low, horizontal structure, is from the inside a most modern 9-story office building. The lobby where we had entered was actually the fourth floor. Below it are three floors containing the general service departments and, of most chemical engineering interest, the facilities for pilot plant and large-scale experimentation. The fifth to eighth floors are given over to laboratories while the ninth houses the ventilating equipment.

Viewed from the outside, the apparent absence of windows, might make one naturally wonder about the provision for lighting. As a matter of fact, all of the offices and laboratories face on interior courts that have been surfaced with glazed ivory terra cotta to reflect the maximum of natural daylight through the many exceptionally large windows.

Beginning now at the bottom, let us take a quick trip and inventory of the different floors. Here three stories below the Dithridge Street level, we find the equipment for supplying compressed air, vacuum, hot water, and refrigerated cold water. Here, too, is the air conditioning equipment for the auditorium, the main switchboard, motor generator sets and the main plug-board to provide single and three-phase electricity and other currents of special characteristics. Not yet completely installed, but with space adequately provided, are the large engineering laboratories which will occupy an L-shaped area two stories high, covering most of the South and East sides of the building. Here machinery and processes are developed and applied to translate reseach into semi-commercial production. Special facilities are also provided for physical testing equipment and for certain unit operations such as crushing and grinding, distillation and evaporation.

A word about the Institute's policies on "large-scale equipment" is perhaps in order here. When a process, developed during the course of a fellowship, demands apparatus of special type, which is not available in the donor's factory, a unit plant is built. Generally this plant is of such a size and is constructed in such a way that, when it is fully developed, the donor will wish to adapt it in his plant and will invest sufficient money to put in a larger unit or a battery of several smaller units.

In the case of a number of these semi-commercial plants in which processes have been developed, the equipment is still available and in the past has been located in small temporary buildings near the Institute. Having in mind that such unit plants can often be adapted to the study of other new processes, the Institute has been gradually acquiring additional "large-scale equipment" and eventually this will all be placed in fully adequate quarters in the new building.

The feature of the second floor is the auditorium—a beautifully paneled room with 350 seats pleasantly and comfortably upholstered in red leather. Also located on this floor are machine, wood-working, pipe, sheet-metal, and electrical shops. And to complete the variety, a cold-storage room, the electrochemical laboratories and the electrical furnace rooms are there too, but all are

completely isolated from the auditorium so there can be no interference with its functions.

The third story, which is at street level on the Bellefield side, provides the lobby for the auditorium below and features the social rooms and accompanying facilities, including a large and well appointed kitchen. Here the Robert Kennedy Duncan Club has its spacious quarters. The fourth or main floor is given over largely to the offices of the director and his executive staff. Its outstanding feature is the spacious library, finished in the style of the Renaissance and believed by many to be the most beautiful room in the building. Floors and ceilings are of broad boards of Slavonian oak with walls of English oak. Again in the handsome wood carvings is seen the symbolism of science at work through research in creating, constructing and improving the manufacture of many essential commodities.

From the fifth to the eighth floors, one finds the laboratories and special research facilities. This part of the building expresses eloquently the years of study given over to laboratory construction by Assistant Director Harry S. Coleman. Special systems for wiring and piping were evolved which made these facilities accessible, yet out of the way. Wall brackets are built so that shelves may be placed at will and easily removed. Cabinets were constructed so that a complete unit can be shifted to another laboratory when desired. Furniture is made without bolts or screws—yet can be quickly assembled. The fume hoods are of cement-asbestos board, and the sinks are of a new impregnated ceramic material developed at the Institute.

The Department of Research in Pure Chemistry is housed in part of the fifth floor. On the sixth is the general storeroom, analytical rooms, glass-blowing shop and the constant temperature and humidity rooms. Most of the seventh floor is given over to organic chemistry. The eighth floor houses the furnace room for research on ceramics and also the animal quarters for nutritional and pharmacologic work. The attic is used for the ventilating equipment and the roof over the main part of the building is of special design to preserve the architectural beauty of the structure.

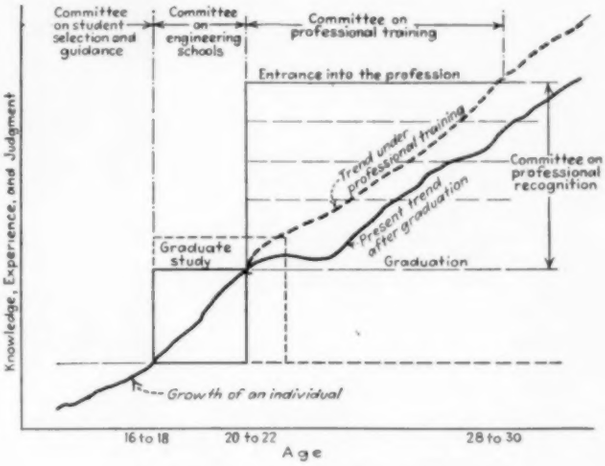
The exterior architecture of the Institute demanded a simple, very plain roof that made it necessary to conceal all outlets of flues, pipes and other facilities which cannot always be avoided in laboratory buildings. Mellon's architects solved the problem by building "fume gutters," constructed directly in back of the attic wall to an approximate width of six feet and entirely surrounding the building. Other gutters extend longitudinally along the center wing. Since all flues and exhaust pipes have their outlets in these gutters, there are no unsightly projections to mar the symmetry of the main roof. Some of the gutters have terra cotta side walls and copper bottoms while some are lined entirely with painted copper.

Over the part of the building inclosing the hollow square, the sloping roof is of aluminum—a reminder of the fact that the new Mellon Institute contains more of this metal than has ever been used before in a single structure. At the dedication banquet, Toastmaster Arthur Vining Davis, chairman of the board of the Aluminum Company of America, noted this fact with some satisfaction, for it seems that, prior to this time, the new building in Washington of the Department of Justice had held this distinction and, as we all know, there is more or less friendly rivalry these days between Washington and Pittsburgh.

E.C.P.D. Report Stresses Personal Development

ENGINEERING PROGRESS requires development of the individual as well as of the science. It was with this in mind that the national engineering societies some five years ago jointly organized the Engineers' Council for Professional Development and dedicated it to the raising of the status of the engineer.

In its fourth annual report the Council has charted the course of the average engineer during his period of development and from this has defined the field of each of its committees.



Development of the average engineer

During the past year the committee on student selection and guidance has extended the use of tests to measure basic aptitudes helpful in determining qualifications for success in an engineering career. It has edited a manual for the aid of vocational guidance committees, a pamphlet entitled "Engineering: A Career—A Culture" for high school students, and has aided in arranging a counseling program in Detroit whereby hundreds of high school boys learned about engineering and were given an opportunity to consult with members of a dozen technical societies. The accrediting of curricula of engineering colleges in Maryland, Pennsylvania and northeastern states has been completed by the committee delegated to that work, and consideration of curricula throughout the rest of the country is now proceeding with the expectation of completion this year.

Particular effort has been directed toward eliminating the flat portion of the personal development curve which indicates negligible progress immediately after graduation from college. The committee on professional training has endeavored to encourage personal initiative on the part of men in this period by making available to them a personal appraisal blank, a list of convenient educational facilities, a general reading list and a technical bibliography, and it has aided in the inauguration of several group programs for junior engineers. In all cases its policy has been one of stimulating and encouraging the young engineer to take his development into his own hands.

The committee on professional recognition is working to improve state registration laws and to strengthen correlation of the three stages of professional development.

What T.V.A. Is Doing in CERAMIC RESEARCH

By R. E. GOULD
CHIEF CERAMIC ENGINEER
TENNESSEE VALLEY AUTHORITY
NORRIS, TENN.

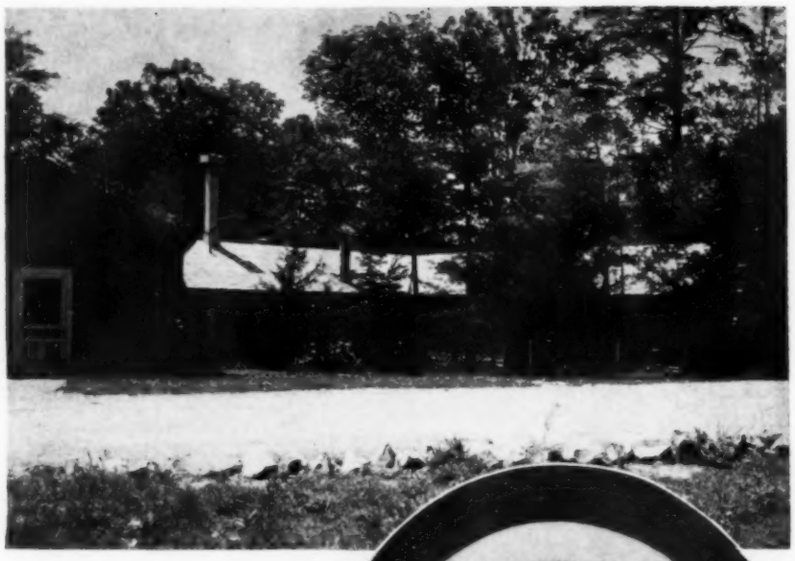


Fig. 1—Part of ceramic research laboratory building

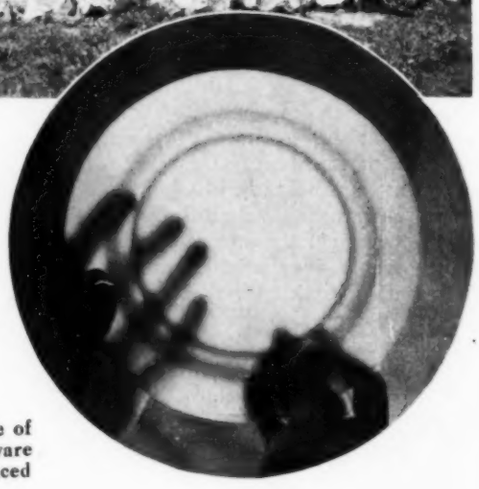


Fig. 2—Type of translucent ware being produced

PRACTICAL industrial research, particularly on those branches of ceramics where electricity could be used as the heating medium, was the purpose for which the Tennessee Valley Authority ceramic research laboratory at Norris, Tenn., was established.

Ceramics is one of the oldest known crafts but unfortunately has not advanced in technology and working methods as fast as many of the newer industries. Some types of ceramic ware are not manufactured in America owing to the fact that extremely low-priced labor in foreign countries makes it practically impossible to compete when using the same working methods.

The program set up for the laboratory had three main objectives:

1. The development and testing of electric kilns or furnaces operating at temperatures between 1,100 deg. and 1,400 deg. C.

2. The investigation of ceramic raw materials occurring in the Tennessee Valley, especially the white-burning primary kaolins with characteristics approximately the same as the English china clay, which is the main plastic material used in the better types of American whiteware such as vitreous china, sanitaryware, electrical porcelain, and similar materials.

3. The carrying on of practical research on vitreous dinnerware made from American materials and fired electrically. It was hoped that the results of the experiments might point the way toward the establishment of industries making a medium-priced, vitreous, translucent dinnerware of a type now almost exclusively imported from the low-wage-paying countries.

This last object was chosen as the first particular problem because of the high temperatures required for firing the vitreous dinnerware and because it requires a controlled atmosphere in the firing process which should be comparatively easy and practical when using electric heating. Also by using American kaolins as the main plastic body constituent, the thin ware produced would be a very rigorous test for the materials and working methods.

Industrial heating by electricity at the temperatures mentioned above is not generally regarded as practical by manufacturers because of three fundamental reasons:

1. There is a general belief that no practical nonmetallic resistor exists which would have a commercial life at these temperatures.

2. Even if such an element existed, the temperature conditions within a furnace would be apt to vary greatly from the source of the heating because of the probable lack of convection within the furnace.

3. The cost of electricity as a fuel, even with reason-

able rates, would probably greatly exceed an equivalent heat unit produced by gas, oil, or coal.

These arguments are certainly not without foundation. However, there appears to be a possibility of using electrical energy as an economic heating source because of the clean and controllable heating and possibly a higher efficiency than is obtainable when using a combustible fuel. In an electric furnace it would seem easier to apply heat when and where it was desired rather than relying upon the cooling of combustion gases such as is usually done in continuous heating practice in kilns using a combustible fuel. Stack losses, large quantities of excess air, and dead weight of kiln furniture or other refractories reduce the efficiency of the average fuel-fired furnace so that if it were found possible to raise the percentage of usable heat in an electric kiln where these features are not present, then the extra cost of the electrically produced heat unit should be largely offset.

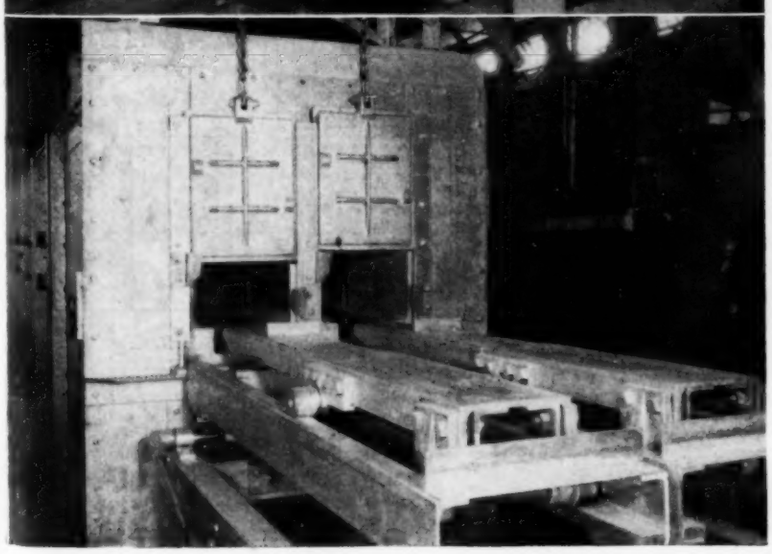
Intensive work was immediately started on testing the available heating elements by placing the commercially sized, and where possible commercially produced, elements in question in furnaces and holding them at the maximum desired temperature continually under controlled conditions until failure occurred. Results were then examined and new tests started, with attempts to correct the faults in order to attain the maximum possible life under loading conditions approximated in practice.

The elements put under test were:

1. A commercially produced recrystallized silicon carbide rod held in the furnace by water-cooled metallic terminals.
2. A laboratory-manufactured graphite resistor consisting essentially of a graphite rod assembly placed in a silicon carbide protection tube to prevent or slow down oxidation.
3. A high frequency induction furnace in which the susceptor is the furnace wall, which is composed of a highly conductive refractory.

Highly encouraging results were obtained with all three types in producing the desired temperatures after a few preliminary trials. With the recrystallized silicon carbide rod, it was found possible to obtain a life of between three and four thousand hours under continuous operation. With the graphite resistor, some tests lasted 4,000 hours, or approximately six months, before failure occurred. The high frequency induction method of heating appears to have distinct possibilities, using a susceptor made from a patented graphitic base material. This susceptor material has been found to resist oxidation at high temperatures to a surprising degree.

Fig. 3—Some of the ceramic preparation machinery
Fig. 4—End of the continuous electric kiln during construction



Resistor Comparisons

At the time of writing, tests have not been carried on to conclusion so that it is impossible to compare the graphite resistor with the recrystallized silicon carbide rod in regard to the actual advantages or disadvantages of each. The chief disadvantages of the recrystallized silicon carbide type appear to be the necessity of water-cooled terminals which are rather expensive and require careful watching and upkeep, and the fact that they change in resistance with age so that this must be compensated for.

As a heating unit, however, this type gives excellent results, and it has been found that in the furnaces tested, the heat distribution is excellent. The heat dispersion from the bars is very high, and by using properly designed furnaces with sufficient elements, the temperature of the heating elements need not greatly exceed the actual temperature of the furnace, a condition which is a distinct advantage.

The graphite-type resistor has some advantages in that it is possible to make the elements on the ordinary lathe,

while the resistor terminals do not require water cooling, making it possible to use a lightly loaded element without the severe drop in efficiency caused by water cooling. It has also been observed that these elements do not change materially in resistance over their life span so that a wide range of voltage regulation is not necessary. The first installation cost of the graphite resistor is higher than when using the recrystallized silicon carbide rods because of the heavy copper necessary to carry the high current and low voltage. On the other hand, the use of low voltage may be regarded as an advantage because of the elimination of the high tension hazard.

Although the primary kaolins of North Carolina have been known for a great many years, their use was never extensive because of the impression of the trade that the available tonnage was small, that the material would probably not be of uniform quality, and that the plasticity or working qualities would be poor. The kaolin as refined was used chiefly as a shortening agent to cut down excessive plasticity when used with the cheaper fat clays. The North Carolina kaolin was known, however, for its very good white color and remarkable firing characteristics, the first of which may be attributed to extremely low iron content and almost complete freedom from titanium dioxide (TiO_2), which fact alone makes this material unique.

Work done at the laboratory was chiefly from the standpoint of disproving the idea of limited tonnage and showing that by proper refining methods the plastic and workable material could be produced at a commercial cost. With the aid of the United States Bureau of Mines and Homer J. Bryson, North Carolina State Geologist, the question of tonnage was quickly settled, it being quite definitely proved that there is enough for many generations to come. Refining the kaolin by dispersion by electrolytes and then making the grain-size separation by flotation pointed the way to a cheap, practical, and above all, a controllable method which yielded a surprisingly plastic clay that retained all of the good qualities of exceptional drying, long firing range, and quite excellent color.

Making a vitreous dinnerware precluded the use of fat ball clays, as these unfortunately harm the color and translucency of the resultant ware to a high degree. It was found, however, that small additions of a highly plastic Florida secondary kaolin made possible the production of workable bodies which seemed to meet the planned specifications.

Some months were required in order to become acquainted with the characteristics of the material so that it could be practically worked. This investigation is still being carried on intensively, but enough has been accomplished to indicate that this phase of the research program will be largely successful.

Work Still to Be Done

A great deal remains to be done in the working out of methods to fit American wages and other conditions. In order to be successful, the dinnerware, if commercially produced, should have a sales cost not exceeding the low priced, foreign made ware which supplies such a considerable part of the American demand at the present time.

Many hundreds of trial burning schedules have been investigated, using bodies made from the North Carolina kaolin and firing in periodic kilns where a reducing atmosphere was introduced before the ware became entirely vitreous. It was found that the bodies permitted quite rapid firing and that the resultant product had a sufficiently wide factor of safety so that the probable

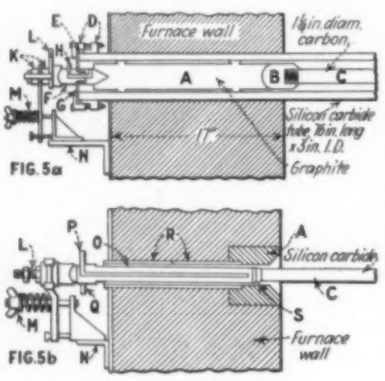
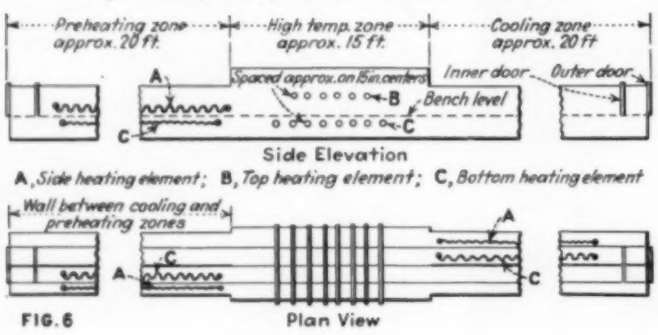


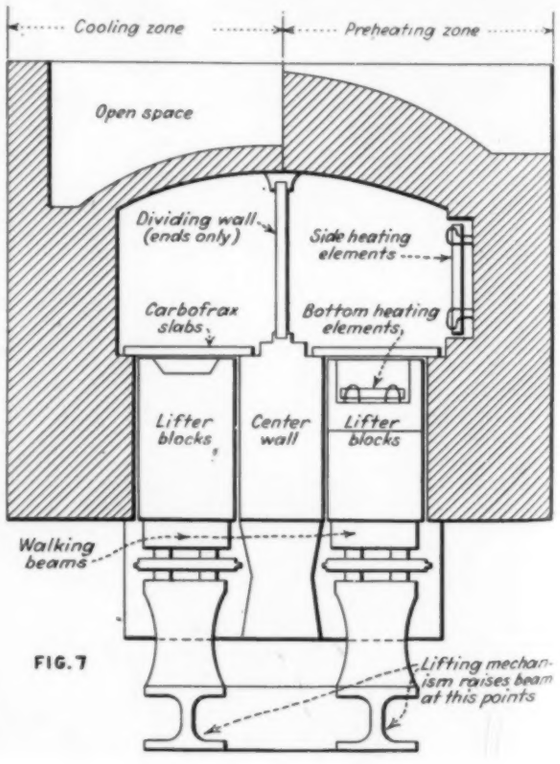
Fig. 5—Resistor assemblies: (a) graphite; (b) silicon carbide

Key to Fig. 5: A, terminal block; B, graphite connector; C, resistor rod; D, cast iron packing rings; E, asbestos packing; F, copper terminal; G, copper diaphragm; H, gas inlet; K, electrical insulator blocks; L, electrical connection; M, adjustable spring pressure; N, mounting support; O, water cooled terminal; P, water inlet; Q, water outlet; R, terminal tubes; S, aluminum shim

Fig. 7—Typical cross sections of kiln in end zones

Fig. 6—Simplified plan and elevation of new kiln


Preheating zone approx. 20 ft.
High temp. zone approx. 15 ft.
Cooling zone approx. 20 ft.
Spaced approx. on 8 in. centers
Inner door
Outer door
Bench level
Side Elevation
A, Side heating element; B, Top heating element; C, Bottom heating element
Wall between cooling and preheating zones
Plan View
FIG. 6



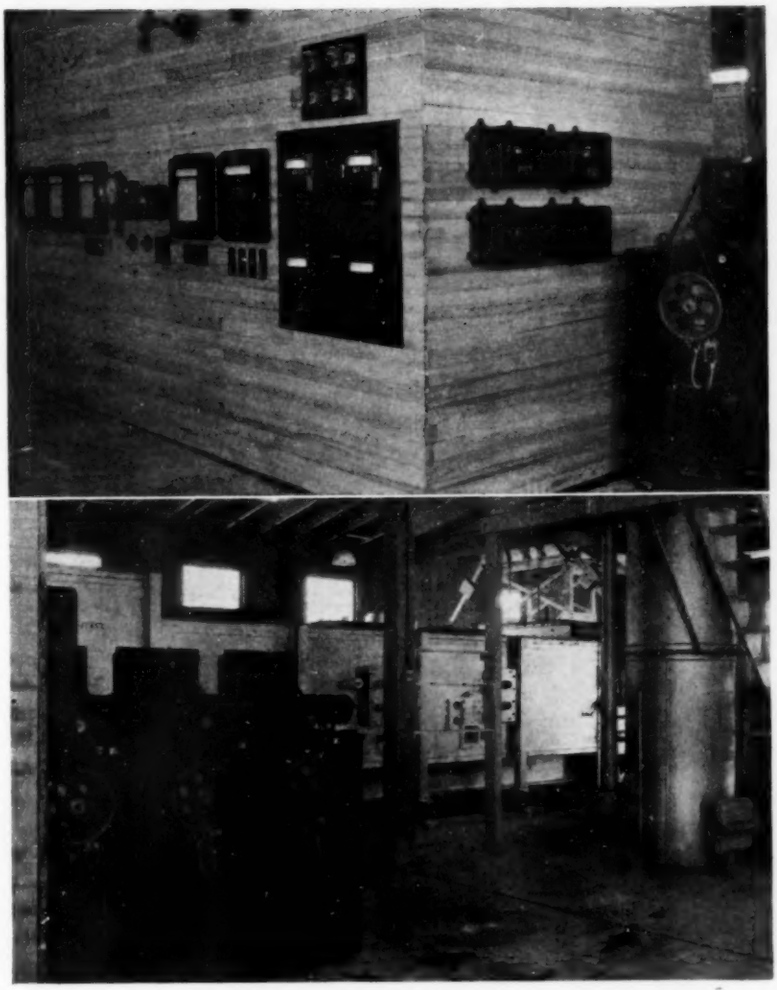


Fig. 8—Constant temperature room and instrument board
Fig. 9—Left to right: The three-phase variable voltage transformer, the kiln and the gas producer for inert kiln atmosphere

speed through a commercial, continuous, electrically heated kiln could be fast enough to obtain enough output from a small cross section to compensate for this limiting feature.

Design of the Electric Kiln

Using these experiments as a basis, a small, continuous, electrically heated kiln is being erected at the laboratory. Attempts will be made in this kiln to:

1. Test out the two types of heating element under actual conditions approximating industrial service. (See Fig. 5.)
2. Experiment with controlled atmospheres.
3. Determine fairly accurately the actual costs in heating to these temperatures on various schedules and to translate the results into cost per unit of ware.

This kiln, sketched in Figs. 6 and 7, has several unique features. Heat is applied underneath and on top of the charge by using the walking beam principle to move the ware through the kiln, thus permitting the resistor to pass through the walking beam, a feature which would, of course, be impossible if cars were used as the conveyors. The continuous kiln is of the counterflow recuperative type, i.e., two streams of ware will pass through it in opposite directions, thus permitting the ware which is cooling to give up at least part of its sensible heat to the incoming ware as the latter is heating up.

These two tunnels are divided, up to the hot zone. The latter will be kept at constant temperature by eight of the resistors in the bottom and six on top. The hot zone will thus be common to both streams of ware, and the time in this period of maximum temperature will serve as a soaking period.

Just before the ware becomes vitreous, a reducing atmosphere is introduced. The presence of carbon monoxide, or perhaps the absence of oxygen, permits ware being fired to be superheated, i.e., carried past the point of complete vitrification and into the temperature at which it would ordinarily develop a vesicular structure, commonly termed overfiring.

Since it appeared more practical to have the hot zone common to both tunnels, it became necessary to zone the reducing atmospheres to the hot zone or at least just outside. This made it necessary to obtain a type of reducing atmosphere which would not harm the ware by depositing carbon or by other bad features if that atmosphere were maintained through the soaking and part of the cooling period. The production of such an atmosphere has been successfully accomplished by a small gas producer using compressed charcoal tablets or briquets. It appears that the fact that these briquets are pressed from dust gives them peculiar burning characteristics which permit the manufacture of an atmosphere of practically carbon monoxide, nitrogen, and small amounts of hydrogen, without any of the usual attendant difficulties of cooling the producer grates with steam, slagging of the refractory walls or burning out of the grate bars. Furthermore, excessive amounts of fuel are not needed in attaining a sufficiently rich gas.

The producer is built for coke, requiring from 1½ to 2 tons of charge per 24 hours. Using the briquets, however, it can be held with a charge as low as 50 lb. per day. Approximately 90 cu.ft. of gas is obtained from 1 lb. of the charcoal tablets. It has been found unnecessary to wash or dry the gas as it is sufficiently clean when leaving the producer.

At the present time, enough progress has been made to give definite indications of the success of the whole undertaking. Time, however, is necessary to prove in a commercial manner such things as actual behavior of resistors, controllability of the atmosphere, the practicability of working bodies such as are being experimented with, and the final cost of the ware if it were to be manufactured on a large scale basis.

New Developments in Catalysts Are Reported

EDITORIAL STAFF

BETWEEN the years 1896 and 1916 the penetration of contact catalytic agents into the process industries first became marked. A new era in the development of contact catalytic processes was ushered in some ten years later by the development of the synthetic production of methanol and the direction of such synthesis towards the production of higher alcohol on the one hand and hydrocarbons on the other. This was followed by many other developments and at the present time many investigations of a catalytic character are under way. For the purpose of making these recent developments known, the Electrochemical Society at its annual meeting in Philadelphia, April 28 to May 1, held a symposium on industrial catalysis in which many authorities participated.

One of the most important catalysts is nickel. Approximately 467,500 lb. of this metal, in various forms and from various sources, were purchased for catalytic purposes in North American countries in 1936. Probably 65 to 70 per cent of the total was used in fat hardening and the balance in a variety of processes. In addition to the metallic form nickel is used in the form of sulphate, formate, carbonate, oxide, and nitrate. It is noteworthy that nickel hydroxide, which was included a few years ago, no longer appears in the list of purchased catalyst raw materials.

The sulphate is favored as the raw material for nickel catalysts by most of those engineers engaged in the commercial hydrogenation of fats, O. B. J. Fraser of the International Nickel Co. stated in his discussion of this type of catalyst. The large part of the formate consumption is also in the fat hardening industry, where it is popular because of the ease with which it can be incorporated into and reduced in the oil. Most, if not all, of the carbonate purchased as such as a catalyst raw material also goes into fat hardening operations.

In addition to the use of nickel catalysts for hardening oil, Fraser covered hydrocarbon purification, hydrogenation, artificial aging of distilled liquors, inorganic hydrogenations and numerous other phases of the subject in his paper on nickel as a catalyst.

Cobalt Occupies Unique Position

Cobalt as a catalyst occupies a unique position. The metal and its compounds are among the most efficient of catalysts due to a number of specific and characteristic properties, such as, for example, the instability of the oxides of cobalt. The uses of this metal were discussed by C. G. Fink, head of the Electrochemical Department at Columbia University. This metallic oxide is the most efficient oxide catalyst for the oxidation of ammonia. Likewise, it is the best oxide catalyst for the oxidation of hydrocyanic acid to NO, an important consideration in the selection of materials for gas masks.

The sulphate is the most active catalyst for the oxidation of sodium sulphite solutions, and ammonium sulphite solutions. With the ammonium salt, cobalt is twice as effective as iron and six times as effective as nickel. The addition of copper sulphate or potassium chromate retards the action of the cobalt salt.

The anodic behavior of cobalt and cobalt compounds has been investigated and the superiority of insoluble cobalt alloy anodes over others is attributed by Dr. Fink to the ease with which cobalt will pass from a lower state of oxidation to a higher state, and vice versa, at relatively low temperatures and pressures.

The uses of cerium and other rare earths as catalysts of hydrogenation, dehydrogenation, and some other types of reactions, were discussed in a paper by B. S. Hopkins and W. A. Taebel of the University of Illinois. The rare earths, especially the oxides, have been known to function as catalysts for a long time. One of the earliest applications of their catalytic nature is that of the Welsbach mantle.

Catalytic Effect of Rare Earths

It has been found that members of the rare earths are effective in the oxidation of benzene to phenol, of toluene to benzaldehyde and benzoic acid. In the case of the lighter alcohols such as methyl and ethyl alcohol the rare earth oxides were found to be too active to give good yields. A 15 per cent yield of acetaldehyde was obtained from ethyl alcohol, the remainder being carbon dioxide and water. Apparently the oxides catalyze the decomposition of the aldehyde.

The catalytic effect of the rare earths in oxidizing reactions is explained by most investigators as being due to the formation of a definite though unstable "intermediate" compound. Peroxides are formed which in the presence of another oxidizable substance transfer a portion of their acquired oxygen to the substance to be oxidized and thus the reaction velocity rate is increased.

All four of the halogens are good catalysts for many reactions. The catalyzed decomposition and oxidation reactions have been investigated by Hans-Joachim Schumacher of the University of Frankfurt, Germany. The involved mechanism may be interpreted either from a chemical or from a physical point of view. In some cases, the molecules of iodine, bromine, chlorine, and fluorine act as catalysts. In other reactions, it is the halogen atom that is the catalyst. Practically all of the reactions of

organic substances catalyzed by iodine can be interpreted chemically rather than physically. Bromine accelerates the decomposition of ozone by forming reactive intermediate compounds (oxides). Relatively few thermal reactions involving chlorine as a catalyst have been investigated. Fluorine catalyzes the decomposition of fluorine oxide Fe_2O_2.

The author called attention to the fact that this interesting and broad field has not yet by any means been thoroughly explored. Even if it has been possible to present interpretations for many experimental results, there are still many problems awaiting solution. But only very careful research will bring further progress.

Of the metal halides aluminum chloride is the most interesting catalyst. The polymerization of olefins by means of aluminum chloride is promoted by hydrogen chloride. Two types of polymerization are caused by aluminum chloride: "true polymerization" and "conjunct polymerization."

The conjunct polymerization of ethylene has been investigated by V. N. Ipatieff of the Universal Oil Products Co., Riverside, Ill., and it has been found that the product consisted of both paraffine and the cyclo-olefinic hydrocarbons. The latter were associated with the aluminum chloride catalyst to form a complex. Then again, the dehydrogenation of cycloparaffins to cyclo-olefins and the hydrogenation of olefins to paraffins is observed.

An Outstanding Development

The successful application of metallic oxides as contact agents for a series of important organic chemical transformations is undoubtedly the outstanding single development in catalysis in the past decade or two, according to Per K. Frolich of the Standard Oil Development Co., Elizabeth, N. J. Because it represents an entirely new approach to organic synthesis, it has given chemical engineers an additional tool of great usefulness. Frolich called attention to the extreme usefulness of these materials in the organic field by the use of specific illustrations. Their high degree of selectivity and their resistance to the ordinary catalyst poisons are their outstanding characteristics. The results obtained in the studies of methanol and higher alcohols are helpful in throwing light on the catalytic and general physical properties of this class of oxides.

The methanol developments led to intensive studies of metallic oxide catalysts. This work brought out the advantages of using mixtures of two or more oxides, generally with the most basic component present in preponderating amounts. Of the numerous combinations suggested, catalysts containing the oxides of zinc and chromium seem to have met with most favor.

It was brought out by Alfred T. Larson, E. I. du Pont de Nemours & Co., Wilmington, Del., that methanol catalysts are reactive at appreciably lower temperatures than ammonia catalysts. One of the earliest commercial catalysts for ammonia was iron to which was added a small percentage of a promoter such as oxides of the alkaline earths. Generally speaking, most methanol catalysts have operating temperatures between 350 deg. and 400 deg. C. Ammonia is the only product of the interaction of nitrogen with hydrogen, but the products of the interaction of carbon monoxide and hydrogen are numerous, often depending upon the catalyst used. Thus, for example, a mixture of zinc oxide and aluminum oxide as catalyst will produce dimethyl ether, and a mixture of zinc oxide and chromic oxide will confine the product to methanol over a wide range of temperature. Sulphur has a serious, poisonous effect on the iron catalysts for ammonia, but has no effect on the zinc oxide-chromic oxide catalyst for methanol.

The mechanism of the catalystic combustion of ammonia was reported by Max Bodenstein of the University of Berlin. He has performed numerous experiments at relatively low pressures. The catalyst was a strip of platinum which was electrically heated. The walls of the reaction vessel were cooled down to liquid air temperature so as to condense certain of the products formed during the oxidation of ammonia. He showed, experimentally and theoretically, that the intermediate products of reaction are hydroxylamine and nitrous acid.

Catalystic Combustion of Ammonia

The mechanism for the catalytic oxidation of ammonia that is suggested the author believes is well founded on facts. However, this does not mean that every detail involved in the mechanism has been thoroughly solved. Thus, for example, he did not even enter the realm of the catalysts, and consider such factors as the action of rhodium as against that of platinum, or that of bismuth oxide as a promoter for the iron oxide catalyst. A good many details which are closely related to this ammonia oxidation problem were not discussed in this paper. Many more investigations are needed before we fully understand all the observations made in practice and in the laboratory. The results of these investigations may, perhaps, suggest a way of improving this very efficient, yet by no means industrially perfect, process.

The recent developments in isotope chemistry, making the isotope deuterium available in quantity, have permitted a striking demonstration of the activation of specific bonds in complex molecules at the same catalyst surface and under identical conditions of reactant concentrations, as Hugh S. Taylor of Princeton University stated. It has been possible to show thereby that definite temperature intervals are required (i.e., different energies of activation) and specific areas of a given catalyst surface are requisite for the breaking of different bonds in a complex molecule such as ethane or propane. The general principle only need here be outlined, and the results stated. In the ethane and propane molecules two types of bond are present, C-H and C-C bonds. At a nickel surface under given conditions, the breaking of the carbon-hydrogen bond can be secured without any scission of the C-C bond whatever. This can be revealed by operating in the presence of deuterium when exchange occurs with formation of deutro-ethanes and propanes without any formation of methane (i.e., no C-C bond split). With ethane on an active nickel catalyst this can be secured in a temperature range of 100-130 deg. C. With the same gas mixture a temperature range of 160 deg. C. must be employed before interaction to yield methane occurs. With propane, the exchange involving C-H bonds begins to be marked at 65 deg. C. whereas hydrogenation decomposition to yield methane and ethane, involving breakage of the C-C bond only becomes marked at 138 deg. C.

A method was described by P. H. Emmett and Stephen Brunauer of the Bureau of Chemistry & Soils, Washington, for measuring the surface areas of catalysts and of other finely divided substances by using low temperature adsorption isotherms of gases such as N_2, A, CO, O_2, CO_2, etc.

New Products Feature Chemurgic Program

EDITORIAL STAFF

TO ADVANCE FURTHER the industrial use of American farm products through applied science was the purpose of the Third Dearborn (Mich.) Conference of the Farm Chemurgic Council, May 25-27. One of the high lights of the meeting was the symposium on new things.

The possibilities of a corn plastics industry were discussed by Pendleton Dudley, executive secretary of the Corn Industries Research Foundation. There are three groups of proteins in corn. The first is free from starch and other carbohydrates and can be used as the base, or as a filler in several kinds of plastics. In the second group are the proteins that dissolve in weak alkali. They can be used as fillers or as components of the phenolic resins, or as a starting point for the making of alkaline coating solutions. The third and most interesting group includes the proteins that make up the substance known as zein. It is an odorless, tasteless solid and practically white. Many of its qualities resemble those of casein and shellac. It is an ideal base for plastics. It harmonizes with many natural and man-made resins and can be compounded into clear, durable finished plastic that stands side by side with the cellulose and resin products.

Cellulose Overcoat for Fruit Trees

Dr. William J. Hale of the Dow Chemical Co., attracted attention with a description of celloveil, a protective hood of ethyl cellulose or cellulose acetate for fruit, tung and other types of trees. The garment sets upon the top of the tree as a mantle and from the rim of the mantle falls a skirt which is gathered about the trunk of the tree. Upon report of threatened cold a gentle application of spray suffices to film over the perforations in the covering, which film will persist for several days at least and bring the temperature within the celloveil some five to twenty degrees higher than the atmospheric mean. In this manner the buds or blossoms remain perfect.

The feasibility of the use of flax and hemp in the manufacture of light weight paper has been recently demonstrated, according to Harry H. Straus, president of Champagne Paper Co., New York. It has passed through its first stages of development and has all aspects of growing rapidly into a large and important farm industrial product. This is the first large scale undertaking to develop paper fiber out of these plants. The future of the industry depends on the results of this year's operation, according to a statement made by President Strauss.

A method of separating the woody portion of the stalk from the fiber has been successfully worked out. This development passed through the usual stages of evolution until today several factory units are in operation. A method for converting the fiber into usable pulp for fine quality light weight paper has also been solved. There are under cultivation, at the present time, about 2,000 acres of hemp in Minnesota and about 20,000 acres of flax in California which are being specially grown for paper purposes.

William W. Buffum of the Chemical Foundation discussed the present status of the power alcohol development at Atchison, Kansas, in which his organization has been interested. Considerable progress has been made not only in the reduction of cost of production but also in the variety of raw materials. He showed the cost of the production of alcohol with the price of corn, rye and sorghums ranging from 30 cents to 90 cents per bushel.

At 30 cents a bushel, alcohol will cost 14.9 cents per gal.
At 40 cents a bushel, alcohol will cost 18 cents per gal.
At 50 cents a bushel, alcohol will cost 20.6 cents per gal.
At 60 cents a bushel, alcohol will cost 23.7 cents per gal.
At 70 cents a bushel, alcohol will cost 26.6 cents per gal.
At 80 cents a bushel, alcohol will cost 29.3 cents per gal.
At 90 cents a bushel, alcohol will cost 31.8 cents per gal.

Alcohol Motor Fuels

Agrol motor fuels have been particularly well received by truck, bus and transport operators, who have found very marked improvement in fuel economy with these fuels, reported Dr. Leo M. Christensen, of the Chemical Foundation of Kansas Co., Atchison. Reports of 20 per cent better mileage with the blends than with gasoline have been common. Presumably this very great improvement has resulted largely from the lessened need to use the gear shift when operating with alcohol blends. Drivers have commonly reported that the engines operate cooler with the blends, that they make better average speed because of greater hill climbing ability and that the engines generally behave far better under conditions of heavy load than they did with gasoline. Tractor operators also have secured beneficial results from the use of Agrol motor fuels and in general it is well proven that the heavily loaded engine benefits most from the shift from gasoline to alcohol blends, a prediction which was made two years ago.

E. F. Johnson, Ralston Purina Co., St. Louis, reported on the domestic soybeans processed in 1935-36. Following is the finding:

Soybean Oilmeal (tons)	
(Own production, bought from members and non-members, and carry-over)	558,879
Utilization:	
For use in feeds	531,081
For industrial purposes	1,003
For export	25,860
Unknown	935
	558,879
Soybean Oil (pounds)	
(Own production, bought from non-members, and carry-over)	185,523,376
Utilization:	
In the edible field	158,077,696
In paint, varnish, linoleum, etc.	15,292,221
Unknown	12,153,459
	185,523,376
Soybean Flour (pounds)	21,915,349

In making this study the conviction grew that these figures deserve the most careful consideration, for the price paid for soybeans must necessarily be governed by the sum received from the sale of the products, which in turn is governed entirely by the consumers who purchase the products.

Readers' VIEWS and COMMENTS

Give a Man a Horse to Ride

To the Editor of Chem. & Met.:

Sir:—Why are many progressive executives lop-sided? Frankly, we don't know. Perhaps our psychologists can explain it. No executive who is worthy of his hire will hesitate to buy equipment or service which will save time, money or increase efficiency, provided the saving is tangible and can be seen by him.

Thus he has no scruples about the purchase of a special accounting machine to take care of social security and old age pension records. He is enthusiastic about getting a new piece of equipment or machinery for the factory which will speed up or lower costs of production. He even gets a kick out of buying a new postage scale which will save a few cents each day. In these examples he can see and measure the benefits which will accrue. On the side of tangible and concrete perceptions he is normally developed.

Let us glance at his other or undeveloped side. Let him see an advertisement or circular describing something which will help the research, development or other departments to get better or faster results. He will agree in spirit but will not act on it because he cannot point out a definite saving in dollars or hours. He takes the path of least resistance and passes it by.

In many cases an engineer, chemist, designer or other technical worker will suggest the purchase of a piece of special apparatus or book. The executive will often frown on such suggestions because he cannot figure out the tangible saving. If he frowns frequently in such cases the technician will lose his initiative and keen perspicacity for new and useful aids and will soon atrophy under such conditions.

The average professional and technical worker is conservative and analytical by nature and training. He is careful rather than impulsive. He knows his needs better than most executives who, even though they formerly did such work, are not as close to it now as before. Such workers are paid to do certain highly intelligent and skilled tasks. They are keenly interested in their work. Should they be helped and given more consideration? That is the question.

Let us consider the following case study: Dr. A, chemist for a paint manufacturer, is unable to match customers' color samples with sufficient accuracy by eye or make-shift devices. He learns of an instrument costing $50 which will help him considerably. He suggests its purchase. The executive in charge suggests that he improvise a similar device and thus save the $50. Dr. A cannot afford to argue his point too strongly and acquiesces. Dr. A then spends about an hour in consulting with the company engineer, three hours in drawing plans, about two hours with his mechanic, and four hours purchasing parts. The cost of parts may be only $8. This is cheerfully O.K.'d by the executive who visualizes a $42 saving due to his shrewdness. *Mais non!* The good Dr. A, for his own personal satisfaction, has drawn up a cost sheet:

Doctor A's time:		
1 hour with engineer		
3 hours designing		
1 hour with mechanic		
4 hours purchasing parts		
1 hour with mechanic		
2 hours setting up and testing		
Total	12 hours @ $3 an hour..	$36.00
Engineer's time:		
1 hour consulting with Dr. A		
1 hour consulting with mechanic		
Total	2 hours @ $3 an hour..	6.00
Mechanic's time:		
2 hours consulting with Dr. A		
1 hour consulting with Engineer		
12 hours labor		
Total	15 hours @ $2 an hour..	30.00
Cost of materials.....		8.00
Grand total		$80.00

The executive would lose face if the good doctor were to present this cost analysis, so the former never learns the error of his ways.

Another type of executive will listen to the doctor's request and gently explain that with the limited budget available he cannot pass an order for $50. Why not do the best he can until a larger budget is created? So without this necessary device, more time is spent by the doctor and his assistants using antiquated and unreliable methods with consequent customer dissatisfaction and perhaps loss of good will and business.

Mr. C is doing research for a drug manufacturer. His work requires much library work to ascertain what other workers in his field have done. The only books which he has are those which he used at school. They are old and few in number. Time and again he has tried to get permission to build a small reference shelf of essential books. He has never been successful in this. Result—he spends at least two or three afternoons each week in a public library. All of this time could be saved and reference books would be on hand whenever wanted, by the expenditure of a small sum.

Many examples similar to the above could be given. They are all cases of being "penny-wise and pound foolish." If a laborer (or professional man) is worthy of his hire, give him the tools he needs. You cannot fail to get a larger return on your investment.

H. Bennett
Editor-in-Chief
The Chemical Formulary
New York, N. Y.

IS THERE A TOOL?

To the Editor of Chem. & Met.

Sir:—On page 208 of the April 1937 issue of *Chem. & Met.* there appears an article on "Current Problems in the Use of Drums." This is an admirable item as far as it goes, but one point, at least, has not been covered.

The point on which we wish to be enlightened is a good method for opening light drums (such as are used for flake caustic and calcium chloride, 400 lb. per drum), so that rapid and complete discharge is possible. The existing opening in the drum's top center does not permit this.

Cutting out the drum head with a hatchet or similar tool is dangerous to the operator. We submitted a can opener design to a manufacturer, but found that he was not interested in producing such a tool.

Does a good drum opener for this type of drum exist in the market today, and, if so, who makes it?

R. N. Johnson
Smith, Kline & French Laboratories
Philadelphia, Pa.

Chemical Engineer's BOOKSHELF

Advanced Organic Chemistry

ORGANIC CHEMISTRY. By *Frank C. Whitmore.* Published by D. Van Nostrand Co., Inc., New York City. 1080 pages. Price, $7.50.

Reviewed by *R. L. Taylor*

ENGLISH-SPEAKING countries have been amply provided for a number of years with good elementary textbooks of organic chemistry, but not until the present work has there been published in English anything in the form of a single inclusive volume which may be used as a text or reference for advanced study. The advanced student and the practicing chemist have been obliged to go either to foreign texts, to uncorrelated abstracts, or to the original literature sources for their information.

The author has used an extremely wide-angled lens in presenting his picture of advanced organic chemistry. The subject matter has of necessity been highly condensed, so much that in occasional instances a rather long mental jump is required in following from one step in a process to the next. Despite these limitations, however, details have been emphasized where their importance warrants. Theoretical background and basic principles are in the main subordinated to experimental work supplemented with observations and industrial considerations taken from the literature and from the author's wide personal experience. From this standpoint the book is an exceedingly practical reference. Its use as such is facilitated further by the extensive index which alone occupies 120 pages.

To some readers the subject matter may seem to emphasize disproportionately the aliphatic and aromatic compounds, the former occupying 615 pages while only 185 pages have been devoted to the latter. This reviewer feels, however, that such a division finds justification in the author's reference to the present trend toward aliphatic chemistry in American and British industry. The sections on alicyclic and heterocyclic compounds are also larger than one would ordinarily expect in a volume of such wide scope.

As well as presupposing a working knowledge of organic chemistry, the author seems to take for granted an exceptional familiarity with the literature on the part of his reader. This constitutes the chief criticism of the work. Since some of the material presented is necessarily so sketchy, those interested in further information will want to refer to the original sources. Reference notes which consist of only the name of the investigator and the year of his work, and in some cases the name alone, do not make the task of tracing back an easy one. There were also a number of typographical errors appearing in the first printing, but these are being corrected in the second which is already under way.

Dean Whitmore is to be congratulated on this new and exceptionally valuable contribution to chemical literature. It will fill a long-realized need.

THE PRACTICAL SIDE OF SOAP MAKING

MODERN SOAP MAKING. By *E. G. Thomssen* and *C. R. Kemp.* Published by MacNair-Dorland Co., New York City. 541 pages. Price, $3 domestic, $4 foreign.

Reviewed by *F. W. Muncie*

AS IS STATED by the authors, this book is designed to serve as a practical volume for the practical soap-maker, little attention being given to theories of saponification or detergency but the emphasis being all on the practical handling and refining of raw materials, kettle practice and other operations in the modern soap factory.

The book is written in a popular style and the treatment of the subject is kept strictly to the practical basis planned by the authors. Much information has been brought together in the volume with which many practical soap-makers may not be familiar. For example: soya bean and babassu nut oils are discussed as soap materials; the I.N.S. (iodine number saponification) and S.R. (solubility ratio) factors are pointed out as aids in soap making; fatty alcohol sulphates as substitutes for soaps, especially in shampoo preparations, are touched upon and directions are included for preparation of sulphonated oils and their use as soapless shampoos; in the chapter headed "Glycerine Recovery" there is included mention of such fat-splitting processes as aqueous saponification, hydrolysis in acetone-water, and the use of ferments.

A number of drawings are given showing layouts for small and medium size soap plants, for vegetable oil refining, soap powder spraying, glycerine recovery and distillation, and fat splitting by the Twitchell and autoclave processes. Under "Perfuming Toilet Soaps" there is a detailed review of the work of Dr. Paul Jellinek on this subject. Extracts are included from *Official Methods of American Oil Chemists' Society* in the chapter on analysis, and the Appendix contains many useful tables of constants as well as U. S. Government specifications for soap products.

The book is recommended as an addition to the library of everyone interested in this field.

A TOOL FOR CHEMICAL ENGINEERS

INDUSTRIAL CHEMICAL CALCULATIONS, second edition. By *O. A. Hougen* and *K. M. Watson.* Published by John Wiley and Sons, New York City. 487 pages. Price, $4.50.

Reviewed by *N. W. Krase*

THE SECOND EDITION of this well known book has been welcomed by chemical engineers in industry and in teaching. The popularity of the first edition leads one to scrutinize carefully the deletions and additions involved in the second edition. The reviewer believes that the removal of material relating to the unit operations is a wise decision on the part of the authors since such material can be more fully treated in books with a less comprehensive scope. With regard to the new material the reviewer feels that the modern approach to the treatment of problems involving deviations from the gas laws will be welcomed. It certainly is time to regard the methods of thermodynamics as applicable to chemical engineering problems. The solutions of such problems are simpler and more direct when approached in this way. The authors have made excellent use of these methods, including much new data not previously summarized in text books.

Many schools feel that this book is the best medium for reviewing physical chemistry and its applications to chemical engineering problems. It will be generally admitted that a course in calculations following the usual first course in physical chemistry is much to be desired in preparation for chemical engineering study. The book is admirably suited for such a purpose.

Chemical engineers in the industry will continue to find this book an invaluable help in practical problems. The material is well indexed and contains many references to the literature.

SOME OF THE FACTS ABOUT CHEMICAL WARFARE

CHEMICALS IN WAR. By *Augustin M. Prentiss.* Chapters on Protection of Civil Populations, and International Situation, by *George J. B. Fisher.* Published by McGraw-Hill Book Co., New York City. 739 pages. Price, $7.50.

Reviewed by *S. D. Kirkpatrick*

HAVING crossed swords recently with some of the more vocal and emotional, if not convincing, of the peace propagandists, this reviewer is well aware of the need for a factual, authoritative book on chemical warfare. No subject of popular discussion has suffered quite so much vilification and abuse by well-meaning fanatics. And all chemical engineers will agree with the author's observation that "chemical warfare has been the happy hunting ground for sensational newspaper and magazine writers whose imaginations have furnished lurid pictures of whole populations being wiped out at a single blow with poison gas dropped from airplanes."

Colonel Prentiss reluctantly undertook the writing of this book as a patriotic duty and with a three-fold purpose in mind: first, to trace the development of the art and science of chemical warfare; second, to present an American viewpoint; and third, to make available to the public an authentic text on a much misrepresented and misunderstood subject of great importance to our future national security.

To cover such a broad range of objectives required a tremendous effort and has produced a most comprehensive manual of interest alike to the technologist and the layman, the professional soldier and the chemical manufacturer. The first of its five parts deals with fundamental considerations of gas warfare, largely from the military viewpoint. Part II is a complete classification and technical exposition of chemical agents—what they are, how they are projected, and what are their effects. Then follow six chapters on the technique and tactics of gas warfare from the standpoints of infantry, cavalry, artillery and air corps. Part IV, Defense Against Chemical Attack, features not only individual and collective military protection but includes a valuable and timely chapter on Protection of Civil Populations by Major Fisher. The final part is of particular interest to chemical engineers and industrialists because it bears on the relation of chemical industry to chemical warfare. Here are valuable facts on inter-relation and inter-dependence of war- and peace-time activities.

Most directly useful to active and reserve officers in our military services and to the executives of the industries on which they must depend for supplies in event of war, nevertheless this book is one that every chemist and chemical engineer will find interesting and helpful in refuting the widespread misinformation about chemical warfare.

WATER ANALYSIS SIMPLIFIED

LABORATORY MANUAL FOR CHEMICAL AND BACTERIAL ANALYSES OF WATER AND SEWAGE, Second Edition. By *F. R. Theroux, E. F. Eldridge* and *W. L. Mallman.* Published by the McGraw-Hill Book Co., New York City. 228 pages. Price, $2.50.

Reviewed by *H. Gladys Swope*

THE SECOND edition of this book is more than a revision of the first. An entirely new section has been added to include the bacteriological examination of water and sewage.

For the non-technical man who must make some tests at a water or sewage plant the book is the most useful guide available, since the directions are explicit and the method of computation is given. For the same reason the book is an excellent laboratory manual for sanitary engineering students who have had only an abbreviated course in chemistry.

Section III, entitled "General Discussion of Chemistry and Related Topics." is extremely useful to the layman or those with only a smattering of chemistry. The reviewer considers this section of primal importance and would have preferred it at the beginning of the book, to be followed by the sections devoted to chemical procedures and preparation of reagents. Likewise, the reviewer would put the "General Discussion of Bacteriology" at the beginning of the section on bacteriological analyses.

The book is an excellent and necessary companion to *Standard Methods of Water Analysis* published by the American Public Health Association.

COLLOIDS IN PERSPECTIVE

COLLOID CHEMISTRY, Fourth Edition. By *Jerome Alexander.* Published by D. Van Nostrand Co., Inc., New York City. 505 pages. Price, $4.50.

Reviewed by *F. E. Schmitt, Jr.*

SO MUCH new material has gone into this fourth edition that Editions I (1919) and II (1924) are drawn upon as outside references. In the last five years, our knowledge of the physical foundations of matter has been extended to the point where a completely new treatment of the colloid state is in order. To accomplish this, the author has adopted a new approach to colloids, taking into account all relevant recent discoveries in nuclear and atomic physics, and welding the new to the well-known in a simple yet complete fashion.

Of the 454 pages of text in this book, roughly the first 40 concern themselves with the physical approach, the next 120 pages are devoted to the properties and behavior of colloids and the reasons therefor, then come 160 pages of practical application of colloid-chemical principles, and the last 160 pages cover the colloidal aspects of biochemistry, genetics, physiology and pathology, mentality, and life and disease.

Despite this astonishing catholicity, the book is in no sense a miscellany. Rather it is a carefully organized treatise on colloids, perfectly coherent around this one central theme. It is not a textbook on colloid chemistry, for while complete in every detail it is not exhaustive. Detailed investigations and tabular matter are omitted; the results only are given, with reference to the original source included in every case. And this is as it should be. For the minutiae, no text can supplant the original paper, and over-concern with each individual step effectively nullifies any attempt to present the general picture, which alone can stimulate further progress.

The author has assumed that his readers will bring at least a bowing acquaintance with the chemistry of colloids. He aims at a comprehensive consideration of all the many fields of investigation and activity in which colloids play a part—to the end that "both breadth and depth of mental focus" may be acquired. This effort is, in this reviewer's opinion at least, well justified in the finished work, and makes a very valuable and stimulating book, rather than just another edition.

NEW KEENAN TABLES

THERMODYNAMIC PROPERTIES OF STEAM. By *Joseph H. Keenan* and *Frederick G. Keyes.* Published by John Wiley & Sons, Inc., New York City. 89 pages. Price, $2.75.

SINCE 1930 the Keenan steam tables have been considered in the light of a standard work throughout the world. Now that thorough-going investigations carried out during the past decade in both the United States and abroad have virtually been completed, longer delay in revision of the earlier compilation has been deemed inadvisable and it seems likely that the new tables will be up-to-date for a long time to come. It is evident that the properties of water in its various forms are now better known than any other composition of matter.

Complete revision has been made, a monumental work in view of the thousands of entries that have been recalculated from new formulations of the properties of water. The tables have been extended to a temperature of 1,600 deg. F. and a pressure of 5,500 lb. per sq. in. absolute. In addition to the previously included tables for temperature conversion, logarithms and con-

version factors, new tabulations and charts cover viscosity, heat conductivity, properties of the compressed liquid, data on ice and its vapor, and other material.

HEAVY CHEMICALS IN FRANCE

LE CONTROLE ANALYTIQUE DANS L'INDUSTRIE CHIMIQUE MINERALE. By *A. Sanfourche.* Published by Masson et Cie, 120 Boulevard Saint-Germain, Paris. 547 pages. Price, 120 Fr.

Reviewed by *A. P. Hartlapp*

DURING the past few years, a high state of development has been reached in the field of analytical method and processes for heavy chemicals. In his book on French manufacture of heavy chemicals, it is the aim of the author to supplement rather than duplicate existing bibliography, hence his omission of such subjects as metallurgy, ceramics, cements, etc., which have been covered adequately elsewhere. He has combined his practical knowledge with the latest manufacturing methods to make this volume as comprehensive as possible.

His book covers in detail important manufacturing methods for synthetic nitric acid, hydrochloric acid, sulphuric acid by the contact process, and phosphate and cyanamid fertilizers. It also deals with metalloids and their composition.

Of great importance are the chapters on analytical procedure. Volumetric methods, gravimetric and densimetric analyses are thoroughly handled. In each case, enough ground has been covered from the theoretical point of view to be interesting and valuable to the operating chemical engineer. Since the contents of this volume are based on laboratory experiments and operating methods which so far have not been written up, it is felt that it will be of considerable interest to the American heavy chemical industry.

POWER HANDBOOK

KENT'S MECHANICAL ENGINEERS' HANDBOOK. (Vol. II Power, of Wiley Engineering Handbook Series.) Eleventh Edition. Edited by *Robert Thurston Kent,* with the collaboration of 28 specialists. Published by John Wiley & Sons, Inc., New York City. 1,254 pages. Price, $5.

FOR OVER 40 years Kent's Handbook has been one of the chief occupants of the engineer's bookshelf, relied on by engineers of every professional persuasion. In this eleventh revision the book takes on a new arrangement and format, calculated to make even more practical and easily applied its already eminently practical content. The volume reviewed here, "Power," is the first of two into which Kent has been split. The second volume covers design and shop practice and will probably prove less useful to the average chemical engineer than this first section.

The book is divided into 17 sections, each of which is individually numbered as if it were a separate book. This device, the cause of the only possible adverse criticism, may prove confusing to users who are not accustomed to it. As for the content, considering the tremendous field that is covered, the reviewer feels only admiration for the competent way in which the various authors have compressed their material into the space available. While the specialist may feel that his field has been slighted, he must realize the scope of the task and turn to the specialized literature for more complete information.

Individual sections of the book cover air, water, heat, combustion and fuels, boilers, engines and turbines, condensing and cooling, refrigeration and ice making, heating, ventilating and air conditioning, internal combustion engines, transportation equipment, electric power, power test codes and mathematical tables.

COURSES IN CHEMICAL AND METALLURGICAL ENGINEERING AT THE UNIVERSITY OF MICHIGAN. Official publication of the University of Michigan, Ann Arbor, Mich. 52 pages.

HERE IS a university catalog which offers something more than a prospectus of courses. In its opening pages it endeavors to clear up as much as is possible through printed words some of the hazy notions held by prospective students as to just what constitutes the

RECENT BOOKS AND PAMPHLETS

Reports of the Progress of Applied Chemistry, 1936. Society of Chemical Industry, Central House, London, E.C.2., 875 pages. Industrial chemistry and chemical technology progress review for 1936, based upon pertinent technical literature appearing during the year.

Tin Plate and Tin Cans in the United States. Bulletin of the International Tin Research and Development Council, 149 Broadway, New York City. 144 pages. Free upon request to the Council. An attractively illustrated story of the tin-plate industry in this country; includes historical survey, statistical review, manufacture of plate and tin cans, discussion of applications, and a supplement containing specifications and statistics.

Vermiculite and Bentonite of Tennessee Valley Region. Bulletin No. 5, Division of Geology, Tennessee Valley Authority, Knoxville, Tenn. Reports on location of deposits and research in properties of vermiculites (talc-like micaceous hydrated silicates) and bentonite (a clay-like mineral probably of volcanic origin).

Brass Pressings. Copper Development Association, Thames House, Millbank, London, S.W.1. 69 pages. Free upon request to the Association. A description of the principal processes employed in the manufacture of strip and sheet products and a discussion of the mechanical properties and composition of copper alloy strip and sheet; prepared primarily for the user of these materials.

Journal of the Royal Technical College. Vol. 4, Part 1. Robert Anderson & Sons, Ltd., Glasgow, C.1, Scotland. Price, 10s. 6d. Record of research in science and applied technology carried out at the Royal Technical College.

National Physical Laboratory Report for 1936. Published by His Majesty's Stationery Office. Obtainable in U. S. from British Library of Information, 270 Madison Ave., New York City, $.80. Scientific and industrial research reports.

Electron Tubes in Industry, by Keith Henney. McGraw-Hill Publishing Co., New York City. 539 pages. Price, $5.00. The purpose of this volume is to acquaint industrial engineers, teachers, and students with the many applications of amplifiers, oscillators, phototubes, rectifiers, thyratrons, grid-glow tubes, and cathode-ray tubes to non-communication industries.

British Chemical Abstracts, Index, 1936, Bureau of Chemical Abstracts, 46 Finsbury Sq., London, E.C.2. 794 pages. Abstracts of papers in pure and applied chemistry appearing in leading technical journals in 1936.

Drilling Mud—Its Manufacture and Testing, by P. Evans and A. Reid. Vol. XXXII, Transactions of the Mining and Geological Institute of India. Obtainable from the Institution of Petroleum Technologists, Aldine House, Bedford St., Strand, London, England. 263 pages. Price, $5. Treats of the manufacture, testing and physical properties of drilling mud.

Copper in Chemical Plant. Copper Development Association, Thames House, Millbank, London, S.W.1. 69 pages. Free upon request to the Association. A discussion of the various chemical engineering equipment which may be fabricated from copper.

Zur Entwicklung der Chemie der Hochpolymeren—Kunststoffe, Kautschuk, Anstrichmittel und Cellulosederivate. Verlag Chemie, G.M.B.H., Berlin. 214 pages. Price, RM 2.80. Contents consist of ten papers in the field of polymer chemistry.

Anuario de Estadistica Minera. Secretaria de la Economia Nacional, Departamento do Minas, Mexico City, Mexico. 345 pages. Mineral statistics of Mexico—1932.

Abfallstoffe der Anorganisch-Chemischen Industrie and Ihre Verwertung, by Emil J. Fischer. Theodor Steinkopff, Dresden and Leipzig. 156 pages. Price, R.M. 9.

Die Verfahren der Anorganisch-Chemischen Industrie, edited by W. Siegel. Urban & Schwarzenberg, Berlin. 591 pages. Price, RM 50. Abstracts of inorganic chemical patents and technical literature which appeared during 1935; classified according to subject.

University of Illinois Bulletins, Engineering Experiment Station. No. 288, An Investigation of Relative Stress in Solid Spur Gears by the Photoelastic Method, by P. H. Black, $.40; No. 289, Use of an Elbow in a Pipe Line for Determining the Rate of Flow in the Pipe, by W. M. Lansford, $.40; No. 290, Investigation of Summer Cooling in the Warm-Air Heating Research Residence, by Kratz, Fahnestock and Konzo, $1; No. 291, Flexural Vibrations of Piezoelectric Quartz Bars and Plates, by Tykociner and Woodruff, $.40; Reprint No. 10, Heat Transfer in Evaporation and Condensation, by Max Jacob, $.35.

Mica, by Nero Passos. Bulletin No. 12, Republica Brazil, Departamento Nacional da Produccao Mineral, Rio de Janeiro, Brazil. 54 pages.

Tantalo, Niobio, Uranio e Radio no Brazil, by O. H. Leonardos. Bulletin No. 11, Bibliotheca do Departamento Nacional da Producao Mineral, Rio de Janeiro, Brazil. 54 pages.

Zinn, by C. L. Mantell and W. Lidle. Wilhelm Knapp, Halle (Saale), Germany; 323 pages. Price, RM 18.75. A comprehensive treatise on tin, its occurrence, metallurgy, properties and chemical compounds.

Dechema-Werkstaffblatter, 1936, edited by E. Rabald. Verlag Chemie, G.M.B.H., Berlin. 104 pages. Price, RM 10. Bibliographic reference on engineering materials of construction for the chemical industries.

duties of a chemical engineer. It explains the scope and meaning of chemical engineering, the part it plays in modern industry, and what will be required of the individual in the profession both during his period of training and after he gets out into the industrial world. While it encourages the serious prospect, it also warns that the programs of chemical and metallurgical engineering are not attractive to students who desire to live an indolent or merely pleasurable life.

There can be no doubt after a study of the bulletin that it is the policy of the department to cull out misfits rather than to persuade young men of doubtful qualifications to choose as rigorous a course as chemical engineering.

BASIC INDUSTRIAL MARKETS IN THE UNITED STATES: The Textile Industries, 49 pages, 5 maps. The Iron and Steel Industry, 37 pages, 9 maps. Gas and Electric Utilities. By *O. C. Holleran.* Published as Market Research Series by the Bureau of Foreign and Domestic Commerce, U. S. Department of Commerce, Washington, D. C. Price, 10 cents each.

A VALUABLE aid to the manufacturer in getting an accurate, visual picture of his market—its density and its potential consuming capacity in different localities—will be found in this series of statistical surveys compiled by the Government's market research staff. Distribution of the producing capacities of each industry is presented geographically by states and counties and is broken down into the individual classes of products included in that industry. For example, the textile industry is broken down into woolen, cotton, rayon and silk goods. In each case the data is conveniently summarized and presented in the form of shaded areas on 10 by 15 inch map supplements.

TALBOT'S QUANTITATIVE CHEMICAL ANALYSIS, Eighth Edition. Revised and rewritten by *L. F. Hamilton* and *S. G. Simpson.* Published by the Macmillan Co., New York City. 280 pages. Price, $2.50.

CHEMICAL ENGINEERS and chemists who at some time during the past 40 years spent their undergraduate year of inorganic quantitative analysis on Talbot (first edition 1897), may be interested in supplementing their shelves with this latest revision. The book is still intended primarily for students, but the clarity of its presentation of the theory and methodology of quantitative analysis—volumetric, gravimetric, and electrometric—renders it useful as a reference tool.

GOVERNMENT PUBLICATIONS

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for its issue.

Technology of Ship-Bottom Paints and Its Importance to Commercial and Naval Activities, by Nathaniel E. Adamson. Navy Department, Bureau of Construction and Repair, C. and R. Bull. No. 10; 10 cents.

Detection and Measurement of Stream Pollution, by M. M. Ellis. Department of Commerce, Bureau of Fisheries Bulletin 22; 20 cents.

Twenty-Second Annual Report of the National Advisory Committee for Aeronautics, 1936; 15 cents.

Application of Sand Filters to Oil-Field Brine-Disposal Systems, by Sam S. Taylor and L. F. Christianson. Bureau of Mines Report of Investigations 3334; mimeographed.

Engineering Report on Oklahoma City Oil Field, Oklahoma, by H. B. Hill and others. Bureau of Mines Report of Investigations 3330; mimeographed.

Annual Report of the Metallurgical Division, Fiscal Year 1936, by R. S. Dean. Bureau of Mines Report of Investigations 3331; mimeographed.

Dust-Prevention Treatment of Solid Fuels, by L. D. Schmidt. Bureau of Mines Information Circular 6932; mimeographed.

Mineral Production statistics for 1936—Preliminary mineographed statements from Bureau of Mines on; zinc; bauxite; iron ore; lead; lead and zinc pigments and zinc salts; aluminum; copper; cadmium; lime; silver; gold; copper, lead, and zinc mining; lithopone.

Federal Specifications. New or revised specifications of the Federal Specifications Board on: Aluminum-alloy (aluminum-chromium-magnesium-silicon), bars, rods, shapes, and wire, QQ-A-331; Cloth, pyroxylin coated, CCC-C-501; Leather, artificial (upholstery), KK-L-136; Milk, dry, powdered, skimmed, and whole, C-M-351a; 5 cents each.

Procurement of Supplies—Bid, Performance, Payment, and Patent Infringement Bonds. War Department, Army Regulations 5-220; 5 cents.

Forestry and Permanent Prosperity. Department of Agriculture Miscellaneous Publication 247; 5 cents.

Certain Aspects of Land Problems and Government Land Policies. National Resources Board, Part 7, of the Supplementary Report of the Land Planning Committee; 40 cents.

Sampling Mine Gases and Use of the Bureau of Mines Portable Orsat Apparatus in Their Analysis. Bureau of Mines, Miners' Circular 34; 10 cents.

American Export Products Benefiting from Reciprocal Trade Agreements Signed Thus Far. Appendix to Congressional Record, 74th Congress, Second Session, Vol. 80, No. 126, July 1, 1936.

Analysis of Miscellaneous Chemical Imports Through New York in 1936. Tariff Commission Release April 20, 1937; mimeographed.

Imports, Exports, Domestic Production, and Prices, Petroleum, Coal, Lumber, Copper, Certain Oils and Fats, Together with Excise Taxes Collected Thereon. Tariff Commission unnumbered document; mimeographed.

Enumeration of Arms, Ammunition, and Implements of War. State Department Release of Proclamation by the President of the United States; mimeographed.

Extent of Equal Tariff Treatment in Foreign Countries. Tariff Commission Report No. 119, Second Series; 15 cents.

Exchange Restrictions in European Countries. Bureau of Foreign and Domestic Commerce, Finance Division Special Circular 421; mimeographed.

Recent Currency Developments in Europe, by Thos. R. Wilson. Bureau of Foreign and Domestic Commerce, Finance Division, Special Circular No. 419; mimeographed.

Foreign Exchange Rates for 1934, 1935, and 1936. Bureau of Foreign and Domestic Commerce, Finance Division, Reprint from Commerce Reports, Feb. 20, 1937.

Advance Statement Containing Final Figures Showing Quantity of Explosives Manufactured and Sold in the United States in the Calendar Year 1936 for Domestic Consumption. Bureau of Mines Release May 13, 1937; mimeographed.

Factory Consumption of Animal and Vegetable Fats and Oils by Classes of Products for 1936. Bureau of the Census Release March 31, 1937; mimeographed.

Rapid Determination of Oil Content and Oil Quality in Flaxseed, by Lawrence Zeleny and D. A. Coleman. Department of Agriculture Technical Bulletin 554; 10 cents.

Poisoning of Livestock by Plants that Produce Hydrocyanic Acid. Department of Agriculture Leaflet No. 88, revised April, 1937; 5 cents.

A Study of Arsenical Dusting of Cabbage in Relation to Poison Residues, by Chas. E. Smith and others. Department of Agriculture Circular 411; 5 cents.

Coated Abrasive Products. Bureau of Standards Simplified Practice Recommendation R89-36; 5 cents.

Retail and Wholesale Prices of Refined Sugar in 22 Selected Consuming Countries, by Albert S. Nemir. Bureau of Foreign and Domestic Commerce, Foodstuffs Division, unnumbered document; mimeographed.

Drainage Basin Problems and Programs. National Resources Committee, unnumbered document; $1.50, 540 pages.

Stumpage and Log Prices for the Calendar Year 1935, by Henry B. Steer. Department of Agriculture Statistical Bulletin 57; 10 cents.

Workers in Subjects Pertaining to Agriculture in Land-Grant Colleges and Experiment Stations, 1936-37. Department of Agriculture Miscellaneous Publication 254; 15 cents.

Psychrometric Tables for Obtaining the Vapor Pressure, Relative Humidity, and Temperature of the Dew Point From Readings of the Wet- and Dry-Bulb Thermometers, by C. F. Marvin. Department of Agriculture, Weather Bureau Publication 235; 10 cents.

Temperature Interconversion Tables (°C—°F) and Melting Points of the Chemical Elements. Bureau of Standards Miscellaneous Publication 126; 5 cents.

Statistics of Capital Movements Between the United States and Foreign Countries and of Purchases and Sales of Foreign Exchange in the United States, Jan., 1935 through Sept., 1936. U. S. Treasury Department, Division of Research and Statistics, unnumbered document.

Control of Insect Pests in Stored Grain, by E. A. Back and R. T. Cotton. Department of Agriculture Farmers' Bulletin 1483; 5 cents.

State and Insular Health Authorities, 1936. Public Health Service Reprint No. 1779; 5 cents. Directory, with data as to appropriations and publications.

City Health Officers, 1936. Public Health Service Reprint No. 1783; 5 cents. Directory of those in cities of 10,000 or more population.

The Efficiency of Rapid Sand Filters in Removing the Cysts of the Amoebic Dysentery Organisms From Water, by John R. Baylis and others. Public Health Service Reprint 1782; 5 cents.

Measurements of Ultraviolet Radiation and Illumination in American Cities During the Years 1931 to 1933. Public Health Service Bulletin 233; 10 cents.

The Public Health Program Under Title VI of the Social Security Act. Public Health Service Supplement No. 126; 5 cents.

National Silicosis Conference. Department of Labor, Division of Labor Standards Bulletin No. 13; 10 cents. Summary Reports Submitted to the Secretary of Labor by Conference Committees, Feb. 3, 1937.

Process Equipment NEWS

Machinery, Materials and Products

Electric Heating Equipment

FOLLOWING a licensing agreement with the National Electric Heating Co. of New York, the Elliott Co., Jeannette, Pa., has acquired exclusive rights to manufacture a specialized line of electrical heating apparatus, developed and applied over a period of several years by the former concern. Some of the earlier types of this equipment were fully described in an article by R. A. Carleton, appearing on pages 102-4 of the February, 1928, issue of *Chem. & Met.*

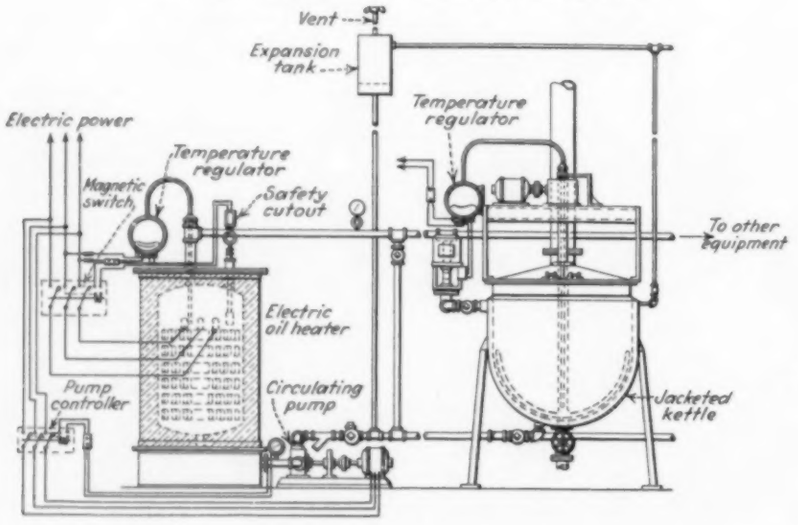
As now supplied by the Elliott Co., this equipment utilizes several fundamentally different means for applying electricity. In the method shown in the accompanying illustration, a submerged electric heating unit in a heavily insulated tank is used to heat circulating oil to any temperature up to 600 deg. F. In this method any number of jacketed kettles or other process vessels up to the capacity of the heating equipment can be connected to the line. An oil circulation system, comprising piping, a vent, an expansion tank and a special hot oil pump is provided. It is stated that, owing to the low temperature differential between the heating unit and the oil and the high rate of circulation, there is no possibility of carbonization of the oil.

For somewhat higher temperatures, generally in the range from 500 to 800 deg. F., a similar heater adapted to the generation of high temperature vapors, such as those of diphenyl, is used. Again one or several process vessels can be heated, being placed on a higher level than the electric heater so that condensate returns to the heater by gravity. In both systems, the vessels can be individually temperature controlled. Using diphenyl at 650 deg. F., the pressure of the vapor is only 50 lb. gage.

The third heating method uses the walls of the container as a heating element, passing through them a suitable electric current of low voltage and high amperage. This type is applied to pipe-heaters, the walls of the pipe being heated. It is also used in connection with pipe lines for the transmission of materials which otherwise would solidify in the line. It is employed in certain applications for heating the walls of process vessels, for heating rolls and drums for dryers, or for heating large sheets used as linings for ovens and furnaces.

Applying certain of the methods described, the company is now in a position to supply complete equipment for a number of operations including a process for the continuous deodorizing of edible and industrial oils such as soya bean oil; a process for the continuous distillation of fatty acids; another for continuous fat splitting; and a fourth for continuous polymerization of oils such as those used in paint and varnish. In general, the methods described are said to be applicable to processes ranging from such low temperature operations as the pasteurizing of delicate materials to the high temperature requirements of coal carbonization.

Electric heating installation employing circulating oil



Gas Regulator

INTERCHANGEABILITY of parts, construction that facilitates any necessary repair, greater accuracy and lessened friction are features claimed for a new line of gas regulators designated CBV, and developed recently by the Reliance Regulator Corp. Division of American Meter Co. The units are available in sizes from 2 to 10 in., built in lever-weighted, spring-loaded and pilot models of both offset and direct-connected types. Both reducing and back pressure regulators are available. The units are designed for ready change from high to low pressure service.

New Products

TO IMPROVE the finishing of wood and wood products as well as other materials such as fabrics, metal, brick and cement, I. F. Laucks, Inc., of Seattle, Wash., has developed a combination of synthetic resins in a special solvent which serves as a priming and sealing material, preventing grain-raising during painting, enameling, lacquering or staining. This material, Laux Rezite Sealer, is said to penetrate the surface and bind down all fibers. This same concern has announced the development of a quick-setting resin which is said to permit perfect bonding of plies in the manufacture of plywood when used in combination with the fast-acting hot presses recently developed by the Merritt Engineering & Sales Co. of Lockport, N. Y.

SELF-VULCANIZING Rubber Co., 605 West Washington Blvd., Chicago, Ill., has announced the recent development of a new rubber covering compound which does not require the use of a primer. This new product, Selfvulc Insulator, is self-curing and cold-curing and can be applied by unskilled labor by dipping, spraying or hand-brushing. It is said to make a sound bond in one application and can be built up to any desired thickness by additional coats. Aside from being an insulator and water-proofer, the new compound is recommended for resistance to alkalis, salt solutions and mild acids and their fumes.

A NEW GROUP of synthetic waxes, having many of the characteristics of carnauba wax, has been developed and announced by the Beacon Co., 89 Bick-

ford St., Boston, Mass. These are known as the Aryl waxes. They are entirely impervious to cold water, and hot water up to the melting point of the wax. They give a high gloss, drying to a hard, shiny surface without rubbing. They are stated to be readily emulsifiable and are suggested for use in such products as floor, shoe and battery-case finishes, automobile polishes, and emulsions for treespraying.

A RECENT ANNOUNCEMENT of the Resinous Products & Chemical Co., Philadelphia, Pa., claims excellent water-resistant properties for the new Tego synthetic resin film used for plywood bonding. It is reported that a number of large panels for pre-fabricated houses were completely under water during the recent Ohio River flood in the plant of one plywood manufacturer. After cleaning and drying they were found to be in excellent condition. Completed pre-fabricated houses erected in Louisville were not submerged to the same extent, but water at the base of the houses is said to have left the Tego-bonded plywood walls entirely unharmed. Several other similar cases were noted during the same flood, none of the plywood having been injured.

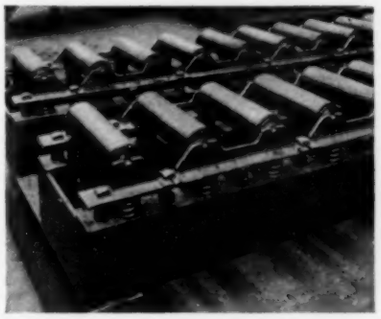
TWO PROTECTIVE CREAMS to be used on the hands of workers who come in contact with chemicals, solvents, greases and oils, have been developed by Maas & Waldstein Co., Graybar Building, New York City. These were worked out for use in the company's own plant and later put on the market. One cream is to be used before beginning work and the other after the work is finished. The complete treatment, in cases where the hands are not wet with water during work, is said to keep the skin soft and prevent the development of fissures and sores.

Vibrating Equipment

TWO NEW vibrating devices, including a screen and a feeder, both of which were developed in cooperation with the Utah Copper Co., have been announced by Allis-Chalmers Mfg. Co., Milwaukee, Wis. Both of these devices operate on a new principle in which standard alternating current is used without resorting to auxiliary equipment such as a motor generator set. The power unit receives its power for operation through a small rectifier mounted on the wall, together with a small auto transformer and amplitude adjusting switch. The rectifier splits the current cycle, one-half of the sine wave being sent to one of the pole pieces, the remaining half to the other. The armature does not touch the magnet, making the equipment quiet in operation.

According to the manufacturer, this mechanism is particularly adapted to

New Utah vibrating screen



Shock-absorbing roller conveyor

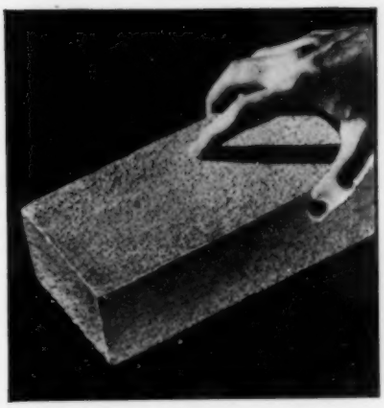
screens having openings of ½ in. or less, either wet or dry. When used with a feeder, it is supplied in two types, one suspended and the other rubber mounted. In addition to ordinary feeding, the feeder is said to be suited for delivering at a substantially uniform rate to crushers, screens, grinding mills and other equipment.

Shock-Absorbing Roller

BASED ON A series of comprehensive tests of the service required of roller conveyors handling heavy objects, the Mathews Conveyor Co., Ellwood City, Pa., has recently announced the development of a shock-absorbing, resiliently mounted roller which in this sort of service is said to minimize the abuse of conveyors and substantially to reduce maintenance costs. With resiliency in the roller mounting, each roller carries its proportionate share of the load and the bearing friction is reduced to normal. Without the resilient mounting, heavy shipping cases, for example, having unevenness or projections, may bear on less than the proper number of rolls designed to support them. With the resilient mounting shown in the accompanying illustration, this lack of contact no longer occurs and overloading of individual bearings no longer takes place.

Insulating Brick

DIRECT EXPOSURE at temperatures up to 2,000 deg. F., and use in installations behind refractory walls in various



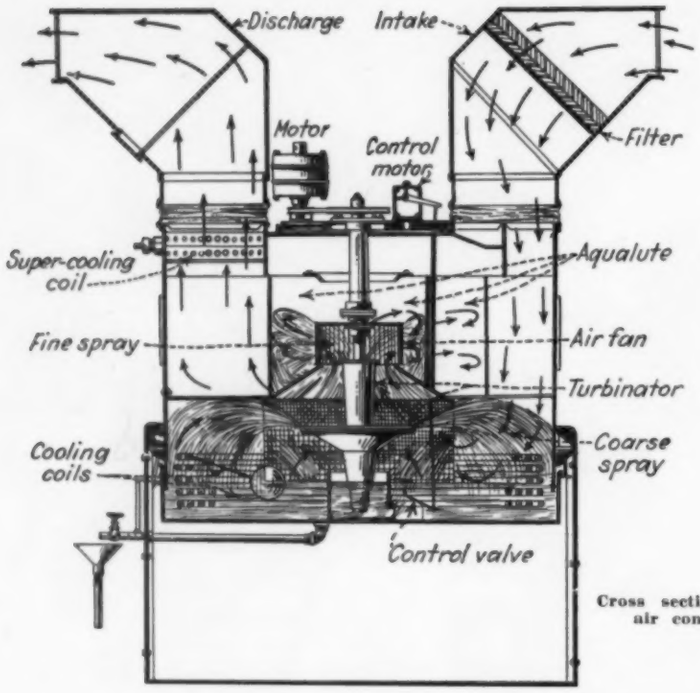
New 2,000-deg. insulating brick

Electric dumping-shovel scoop truck

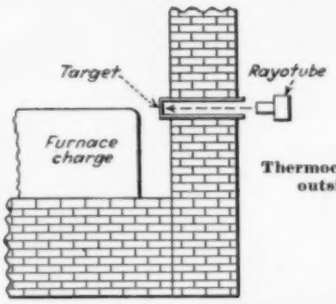
types of high temperature industrial furnaces and kilns, are said to be practical with a new 2,000-deg. insulating brick, known as JM-20 and recently put on the market by Johns-Manville Corp., 22 East 40th St., New York City. The new refractory insulator is produced by combining a high quality refractory clay with a specially manufactured, fibrous, light-weight, inorganic aggregate. The brick is extremely light in weight, weighing less than 1.7 lb. per standard 9-in. equivalent. Its heat capacity is stated to be less than ¼ that of usual refractories and its thermal conductivity, less than ⅛ that of firebrick.

Scoop Truck

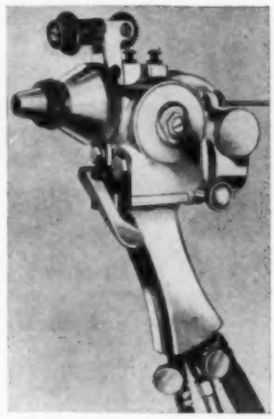
MISCELLANEOUS loose materials such as sand, glass batch, coal and fertilizer ingredients, are readily scooped up at the rate of 10 to 15 cu.ft. per load, for transportation to the destination, by means of a new dumping-shovel scoop truck recently announced by the Yale & Towne Mfg. Co., Philadelphia Division, 4530 Tacony St., Philadelphia, Pa. The new truck, which is electrically operated, is designed to maneuver in close quarters, for example inside a freight car, and is so built that the load, when carried to its destination, can be elevated and dumped at a considerable height. These design features are clearly shown in the accompanying illustration.



Cross section of unit air conditioner



Thermocouple installed outside furnace



New Universal metal spray gun

Unit Air Conditioner

A NEW TYPE of unit air conditioner, available in models designed both for winter and for complete air conditioning, and available in capacities of 500 and 1,000 c.f.m. per unit, has been announced by the Utica Radiator Corp.'s air conditioning division, 101 Park Ave., New York City. The new unit, of course, operates according to recognized principles of air washing, dehumidification, heating and cooling, but in so doing employs two novel devices known as the Turbinator and the Aqualute. These are best explained in conjunction with the accompanying drawing which shows a cross-section of one type of Hydro-Air conditioner, equipped with cooling coils, but no bypass. Another type employs a bypass and double fan, doubling the normal 500 c.f.m. capacity.

The Turbinator is a specially designed spray pump without nozzles, valves, bearings, or moving parts except for the conical pumping element itself. It is a double conical device providing a coarse spray at its large diameter for air washing, and a fine spray at its smaller diameter for humidification. This device is die cast of a special aluminum alloy and treated for permanent corrosion resistance. The Turbinator is suspended by a shaft carried on permanently lubricated bearings, the power unit being carried on rubber to eliminate noise. Air introduced into the conditioner travels through the coarse spray, passing upward through the fan where it comes in contact with the humidifying spray. The fan volute is formed as a continuous spiral of 1½ turns, exerting a scrubbing action on the discharge air and effectively removing all entrainment, according to the manufacturers. This is the Aqualute.

Water for washing and dehumidifying, in the model shown, is cooled by direct expansion of the refrigerant in coils suspended in the water pan. If desired, the unit can be provided with a filter, a super-cooling coil or, if necessary, a tempering coil. Control is obtained through a simple valve arrangement which admits or shuts off the flow of water to the Turbinator.

According to the manufacturer, the unit is particularly intended for use in the air conditioning of moderate volumes, such as specially controlled laboratories and smaller rooms in which manufacturing operations requiring controlled atmospheres are carried out.

Remote Thermocouple

LEEDS & NORTHRUP Co., 4901 Stenton Ave., Philadelphia, Pa., announces the development of the Rayotube, a specialized thermocouple for mounting outside the furnace where it is protected from injurious gases and high temperature. Two types are used: in one type the thermocouple is sighted on a closed-end tube mounted in the furnace wall, as in the accompanying illustration. In the other type, the tube is sighted directly into the furnace so as to "see" the material in process. The Rayotube is made in a wide-angle type for wide area temperature detection and a narrow angle type for temperature detection of smaller areas. The instrument is said to be unaffected by heavy vibration, and is used with a standard Micromax recorder for indicating and recording the measured temperature.

A second new development announced by this company is a simplified cell assembly for flue gas analysis. Contrary to usual practice, the flue gas sample is conditioned by saturating rather than by drying.

Process Equipment NEWS

Metal Spray Gun

IMPROVING its earlier equipment, Metalspray Co., Inc., 113 Llewellyn St., Los Angeles, Calif., has announced the development of a new "Universal" gun said to be suitable for handling all sizes of wire in any metal. The new gun will feed wires from 0.032 to 0.125 in. in diameter at proper speed for melting temperatures ranging from 400 to 4,800 deg. F. As the gun weighs less than 4 lb., it is equally suitable for hand or lathe operation.

Equipment Briefs

FOR TESTING fine materials, the Newark Wire Cloth Co., Newark, N. J., has announced a new "End-Shak" testing sieve shaker which features a simplified hold-down device to permit the ready placement and removal of the sieves, regardless of the number used. The combined reciprocating and turning motion imparted to the sieve is

said to make the screening surface 100 per cent effective while at the same time jerking of the sieve and bumping of the particles are avoided. The machine weighs 145 lb. and will handle from 1 to 13 sieves. It is powered by a ¼-hp. motor.

A NEW TYPE of water-tight bolt has recently been announced by the Mac-Lean-Fogg Lock Nut Co., 2649 North Kildare Ave., Chicago, Ill. This bolt, which is particularly adapted to use in the wooden floors and running boards of steel box-cars, has an absolutely flat head which, when properly installed, is flush with the floor. A rib on its underside contributes to water tightness while a square section of the shank prevents turning. A special type of automatically self-locking nut is provided for use with this bolt.

FOR EXPERIMENTAL use in determining the kind of results which are possible on a production basis, the F. J. Stokes Machine Co., Philadelphia, Pa., has introduced a small motorized tablet machine, designed for compacting, tableting or compressing such products as catalysts, insulators, ceramics, chemicals, dye-stuffs, pharmaceuticals, etc. The machine operates from a light socket, uses a ¼-hp. motor and has an output up to 100 tablets per min. in sizes to ½ in. diameter. Adjustments for weight and hardness of the tablets are simple, according to the manufacturer.

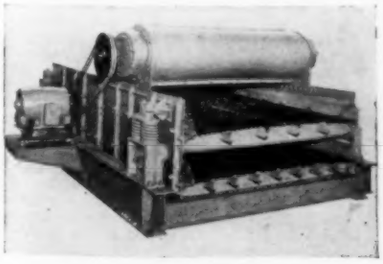
A THREE-PLY construction has recently been employed in a new all-metal flexible tubing, designed for use with steam, water, oil, gas, air, gasoline, varnish, etc., and made by the Seamlex Co., 5-19 48th Ave., Long Island City, N. Y. This tubing, which has been designated T.S.T., is formed by the corrugating of a triple member consisting of an outer seamless bronze tube, an intermediate copper braid and an inner seamless bronze tube. Easily applied fittings requiring no soldering, brazing or packing, are available.

Elliptical-Motion Screen

WHAT IS said to be a new mechanical principle in providing motion to a vibrating screen is found in the new Eliptex horizontal screen made by the Robins Conveying Belt Co., 15 Park Row, New York City. The screen, which is set in a horizontal position or nearly so, depending on the material, is given an elliptical motion over its entire surface by means of a vibrator unit consisting of two shafts geared together and revolving at high speed. These shafts are fitted with unbalanced weights one of which is heavier than the other. When revolving, they produce a compound centrifugal force that gives the screen its uniform elliptical motion.

The frame carrying the screen deck and the vibrator is resiliently supported on cushioning springs which confine the vibration. Friction checks, located at the four corners of the screen, control the motion on starting and stopping. Two or more identical, interchangeable screen cloth panels are used on each deck, attached by a means providing for easy replacement. Single, double, and triple deck models in a wide variety of sizes are provided.

Eliptex screen from discharge end



Locking Pail

A LINE OF 5-gal. pails equipped with an easy-opening, tight-sealing locking ring, for the shipment of solid, semi-solid and liquid materials, has been announced by the National Steel Barrel Co., 3850 East 91st St., Cleveland, Ohio. Owing to the fact that the head is readily removable, the pails are easily filled and emptied. However, if desired, the removable heads may be fitted with pull spouts or other discharging means. No tools are required in removing the head. If desired provision can be made for use of a wire seal.

Portable Mixing Units

AVAILABLE in sizes of 100, 300 and 600 gal., a new portable mixing unit, which is also suitable for stationary service, has been announced by the Mixing Equipment Co., Rochester, N. Y. Developed for use in the paint industry, the unit has also found application in other process and allied industries. It consists of a tank with an agitator of the propeller type introduced near the bottom in an annular off-center position which results in a double-mixing action. It is stated that the mixer housing (which extends into the tank) serves as a baffle, further increasing the mixing efficiency. The built-in explosion-resistant motor is approved by Underwriters' Laboratories.

Pail with quick-removable head

Conveyor Switch

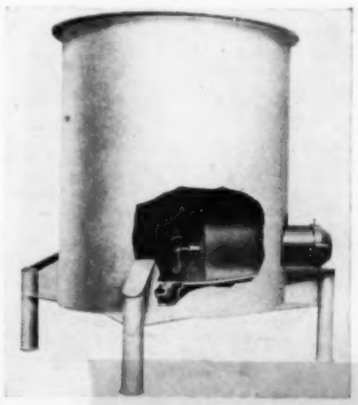
ORDINARILY a flexible switch for use in a roller conveyor system consists merely of gravity rollers. Where several discharges to lateral lines are required, the use of gravity switches results in the main conveyor line being a series of up and down sections. A new switch recently announced by the Standard Conveyor Co., North St. Paul, Minn., provides power to each of the rolls. It permits intermediate discharge of commodities at any one or at numerous points, without any manual effort other than pushing a button, and with a conveyor that may be set horizontal throughout its entire distance of travel.

The switch is moved to its various positions by power, stopping when it reaches the discharge point. After the commodity has passed over, it returns to its normal position without further attention.

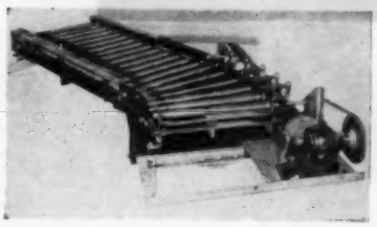
Mechanical Drive Turbine

FOR THE DRIVING of general purpose machinery in industrial plants, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., announces the new Type C mechanical drive turbine, an

Portable process mixer



Powered radial switch for conveyors

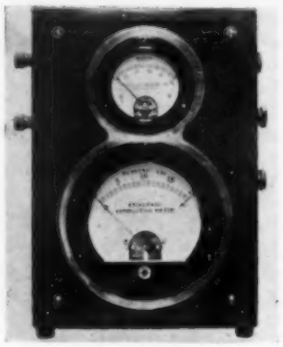


impulse type having one pressure and two velocity stages. The new turbines are built in capacities from 5 to 500 hp. at speeds from 1,000 to 5,000 r.p.m. They may be operated either condensing or non-condensing, with rotation in either direction, at steam pressures up to 650 lb. gage and total temperatures up to 750 deg. F. Among the uses suggested by the manufacturer are the driving of pumps, forced and induced draft fans, compressors, Jordans, pulp beaters and similar equipment, either direct or through belt or gear drive. An important feature is the ease with which they may be adapted to the skimming of byproduct power from process steam.

Combination Pressure Gage

PRESSURE measurements on viscous liquids as well as corrosive materials is the field of a new gage introduced by the Jas. P. Marsh Corp., 2073 Southport Ave., Chicago, Ill. The new gage combines a standard bourdon tube and a diaphragm housing. The whole system is filled with a non-freezing liquid. Pressure applied to the diaphragm causes the liquid to operate the bourdon tube. Thus, according to the manufacturer, the new construction combines the accuracy and dependability of the bourdon tube gage with the non-clogging features of the diaphragm gage. Calibration in pounds or feet of liquid in almost any range desired is obtainable at the user's option.

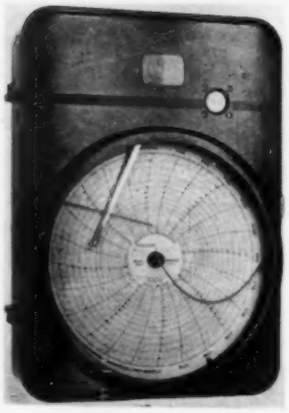
Process Equipment NEWS



Electric combustion meter

Combustion Meter

A SMALL portable combustion meter for the determination of flue gas temperature and CO_2 content of the gases has recently been developed by Charles Engelhard, Inc., 233 N. J. Railroad Ave., Newark, N. J. The instrument is of the electric type, operated from dry cells contained within the case. The CO_2 measuring element employs the thermal conductivity principle and is said to be very rapid in operation.



Electric flowmeter recorder

Electric Flowmeters

ADDITION of a complete line of electric flowmeters for steam, liquids and gases, supplementing its line of mechanical flowmeters, has been announced by the Bristol Co., Waterbury, Conn. These meters operate on the Bristol Metameter principle of telemetering which has been employed for a number of years by the company in instruments transmitting readings of pressure, liquid level, temperature and motion. The new flowmeters are furnished for recording, integrating and indicating, the readings being transmitted over a simple two-wire circuit which does not enter into the calibration of the instrument.

MANUFACTURERS' LATEST PUBLICATIONS

Air Conditioning. Carrier Corp., 850 Frelinghuysen Ave., Newark, N. J.—Folder listing users of and describing advantages of this company's centrifugal compressor for air conditioning and process cooling.

Alumina. Aluminum Co. of America, Pittsburgh, Pa.—Form AD-121—41-page booklet on properties and uses of activated alumina, together with appendix of tabular and charted engineering data including psychometric data.

Apparatus. American Instrument Co., 8010 Georgia Ave., Silver Spring, Md.—Publication on soil testing instruments and apparatus with information on making of soil tests; also bulletin 842-CM, 4 pages on this company's new monochromatic light source and new Type V photometer.

Bearings. New Departure Division, General Motors Corp., Bristol, Conn.—Booklet S—146-page 1937 standard catalog of this company's ball bearings with data on bearing selection, mounting directions and other engineering information; also Form 205, 19 sheets containing full-sized drawings of bearing layouts.

Chemicals. Eastman Kodak Co., Rochester, N. Y.—Organic Chemicals List No. 28—124-page catalog and price list of organic chemicals made by this company.

Chemicals. Merrimac Chemical Co., Everett Station, Boston, Mass.—24 pages on anhydrous ferric sulphate in water and sewage treatment.

Coatings. Quigley Co., 56 West 45th St., New York City—Bulletin 281-B—8 pages describing Triple-A No. 20, a heavy duty black coating for prevention of corrosion and decoration of iron, concrete and other surfaces.

Coatings. Skybryte Co., Cleveland, Ohio.—14 pages on corrosion resisting paints, concrete and cement paints, wall paints, roof coatings, rust solvents, and similar materials.

Compressors. Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Bulletin 1910—12 pages on rotary, centrifugal and reciprocating blowers and compressors made by this company.

Crushers. Traylor Engineering & Mfg. Co., Allentown, Pa.—Bulletin 3012—18 pages describing Type TY gyratory reduction crushers, with information on maintenance and uses.

Doors. Cornell Iron Works, 36-20 13th St., Long Island City, N. Y.—12-page catalog describing upward rolling doors and grilles for factories and other purposes.

Dryers. Proctor & Schwartz, Inc., 7th St. at Tabor Road, Philadelphia, Pa.—Bulletin 158—6-page folder briefly describing a range of dryers for chemical process industries.

Dust Collectors. C. O. Bartlett & Snow Co., Cleveland, Ohio—Bulletin 79—36 pages with engineering data on dust collection, theory and practice.

Dust Collectors. Claude B. Schneible Co., 3951 Lawrence Ave., Chicago, Ill.—Catalog 10—24 pages on this company's multi-wash method of dust collection, including also information on sludge dewatering tanks, sludge pumps and accessories. Also 8-page engineering analysis of installation of dust suppression equipment made by this company.

Dust Collectors. W. W. Sly Mfg. Co., 4700 Train Ave., Cleveland, Ohio—Bulletin S-85—16 pages on dust control systems with emphasis on dust filters made by this company.

Electrical Equipment. Allen-Bradley Co., Milwaukee, Wis.—26 pages completely describing this company's solenoid starters for electric motors.

Electrical Equipment. Century Electric Co., 1806 Pine St., St. Louis, Mo.—8-page bulletin describing repulsion-start induction motors of the brush-lifting, single-phase type.

Electrical Equipment. Elliott Co., Jeannette, Pa.—Bulletin L-6—24-page bulletin describing, largely with illustrations, generators and motors of all sizes and types made by this company.

Electrical Equipment. General Electric Co., Schenectady, N. Y.—Publications as follows: GEA-529C, low-speed synchronous motors; GED-650, 60 pages discussing at length electric heating devices and units for many types of small heating jobs; GEA-821F, pressure and vacuum switches, diaphragm type; GEA-1061F, 32 pages on strip-chart recording instruments; GEA-2253A, modern switchboard styling; GEA-2472, automatic switchgear; GEA-2492, fractional horsepower motors; GEA-2532, "tips" to assist users in determining cable uses.

Electrical Equipment. Struthers Dunn, Inc., 139 North Juniper St., Philadelphia, Pa.—Leaflet illustrating relays, timing devices, thermostats, counters, melting pots and other electrical equipment made by this company.

Electrical Equipment. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.—Publications as follows: Descriptive Data 3105, describes new heat exchanger principle employed in dual ventilated fan-cooled Type CS squirrel-cage motors; Catalog Sections 43-350 and 61-180, respectively, miniature panel instruments; and 32 pages on 200 and 400 watt high-intensity mercury vapor lamps.

Equipment. Edge Moor Iron Works, 30 Rockefeller Plaza, New York City—Bulletin 103—8 pages describing this company's production facilities, and illustrating a variety of special fabricated processing equipment.

Equipment. Patterson Foundry & Machine Co., East Liverpool, Ohio—12-pages on this company's Typhoon portable agitators with brief information on other agitator types; Catalog 372, 32 pages describing in detail laboratory and production size ball and pebble mills made by this company.

Equipment. F. J. Stokes Machine Co., Philadelphia, Pa.—Bulletin 625—8-page leaflet describing laboratory and industrial water stills; Bulletin 701, 6 pages describing methods of filling and sealing collapsible tubes.

Equipment and Construction. Pittsburgh-Des Moines Steel Co., 3456 Neville Island, Pittsburgh, Pa.—Bulletin 103—8 pages on steel tanks, sedimentation basins and filters made by this company; also Bulletin 602, 12 pages picturing some of this company's construction activities in pipelines, water treating plants, irrigation systems and steel structures.

Expansion Joints. Foster Wheeler Corp., 165 Broadway, New York City—Bulletin C-37-4—12-page leaflet describing several modifications of this company's Type S stainless steel bellows-type expansion joint.

Fans. Clarage Fan Co., Kalamazoo, Mich.—General Catalog, Third Edition—36 pages on air handling equipment including fans, blowers, unit heaters and coolers, air washers and accessories.

Fluids Handling. Walworth Co., 60 East 42d St., New York City—Vol. 1 No. 1 of "Walworth Today," a 12-page bimonthly magazine, devoted to valves, fittings, pipe, and similar equipment.

Fluids Handling. Worthington Pump & Machinery Corp., Harrison, N. J.—Publications as follows: Bulletin L-612-B3, 20 pages on opposed steam-driven compressors; L-621-B5, vertical, single-cylinder, single-stage air compressors; W-318-B7A, 1200-lb. boiler feed centrifugal pumps; W-360-B1, centrifugal paper stock pumps.

Furnaces. Geo. E. Reintjes Co., 2517 Jefferson St., Kansas City, Mo.—Bulletin 201—4-page folder describing new simplified arch construction for furnaces recently announced by this company.

Gears. D. O. James Mfg. Co., 1120 West Monroe St., Chicago, Ill.—8-page leaflet describing this company's facilities for gear manufacture, illustrating range of gears produced.

Graphite. Acheson Colloids Corp., Port Huron, Mich.—Technical Bulletin 270.1—6 pages on the uses of colloidal graphite, covering a wide range of applications.

Heaters. Ross Heater & Mfg. Co., 1407 West Ave., Buffalo, N. Y.—Bulletin 1062—24 pages with engineering data on tube type instantaneous heaters for water and process liquids.

Heating Equipment. Elliott Co., Jeannette, Pa.—Bulletins M-1 and M-2—Respectively 12 and 4 pages, covering a range of automatic electric heaters and heating equipment; and a continuous deodorizing system for edible and industrial oils.

Heat Transfer. Whitlock Coil Pipe Co., South St., Elmwood, Hartford, Conn.—Bulletin 366-SW—12 pages on storage heaters, submerged heaters, instantaneous heaters, feed water heaters, oil heaters, heat exchangers and other heat transfer equipment.

Instruments. American Schaeffer & Budenberg Division, Consolidated Ashcroft Hancock Co., Bridgeport, Conn.—Bulletin 2400—8 pages describing construction and uses of this company's wide-range non-indicating controller for temperature or pressure. Also leaflet describing dial thermometers with stems adjustable to any angle.

Instruments. Automatic Temperature Control Co., 34 East Logan St., Philadelphia, Pa.—Bulletin G-14—4 pages on unusual time controls for sequence timing designed by this company.

Instruments. The Bristol Co., Waterbury, Conn.—40-page catalog on electrical and mechanical flowmeters; also bulletins 483, 484, 485 and 486, on recording and controlling gages.

Instruments. Brown Instrument Co., Philadelphia, Pa.—Catalog 15-C—40 pages describing indicating, recording and controlling millivoltmeter type pyrometers; Catalog 3005, 24 pages illustrating and describing electric indicating and recording carbon dioxide meters.

Instruments. Esterline-Angus Co., Indianapolis, Ind.—Catalog 337—88 pages describing complete line of recording instruments made by this company, covering 7 types of instrument case, 21 different chart drives and 24 kinds of metering elements.

Instruments. Julien P. Friez & Sons, Inc., Baltimore, Md.—4-page folder completely describing a new standard water level recorder of portable construction.

Materials Handling. Baldwin-Duckworth Chain Corp., Springfield, Mass.—"Dossier A-1"—8-page bulletin on conveying equipment for high temperatures, presenting in amusing fashion an example of the adventures of "A. Balduck," an engineering Sherlock Holmes, engaged in tracking down his ancient enemy, "Criminal Waste."

Materials Handling. Chain Belt Co., Milwaukee, Wis.—Catalog 270—114-page catalog with unusually complete engineering data section on design and application of belt conveyor installations.

Materials Handling. Cleveland Crane & Engineering Co., Wickliffe, Ohio—Form G237—8 pages on the planning of a materials handling system to avoid waste and rehandling and increase capacity.

Materials Handling. Lewis-Shepard Co., 267 Walnut St., Watertown, Mass.—Circular 322—Leaflet briefly describing lift-truck platforms and lift-trucks.

Materials Handling. Link-Belt Co., 307 North Michigan Ave., Chicago, Ill.—Folder 1435—4 pages describing this company's new Super Salem steel elevator buckets.

Metal Hose. Chicago Metal Hose Corp., Maywood, Ill.—26 pages describing this company's Rex-Weld and Rex-Tube flexible metal hose, with information on construction, installation and uses.

Metal Refining. Handy & Harman, 82 Fulton St., New York City—Bulletin 2—10 pages describing this company's facilities for refining precious metals, describing both equipment and laboratories.

Meters. American Meter Co., 60 East 42d St., New York City—6 pages describing recent improvements in steel case gas meters.

Optical Apparatus. Bausch & Lomb Optical Co., Rochester, N. Y.—Catalogs D-12, D-130, D-185, D-221—18- to 22-page catalogs covering respectively research microscopes, polarizing microscopes, laboratory microscopes, and spectrometric equipment.

Packings. Metalastic Mfg. Corp., Hackensack, N. J.—16 pages illustrating and describing the range of industrial packing materials made by this company.

Paper. Paper Service Co., Lockland, Ohio—Leaflet briefly describing this company's "X-Creped" paper for bags, liners, etc., a paper creped on two intersecting diagonals, characterized by stretchability in all directions, waterproofness and vaporproofness.

Petroleum Engineering. Waverly Oil Works Co., Pittsburgh, Pa.—Ninth Edition of the Waverly Handbook—Over 900 pages of technical, engineering and chemical data, pertaining to the petroleum industry, including considerable information never before published. Price $1.50 per copy or $2 for special deluxe edition.

Power Transmission. Alexander Bros., Inc., 406 North 3d St., Philadelphia, Pa.—Catalog A-117—32 pages with description and engineering data describing this company's Tentacular belt drives.

Proportioning. D. W. Haering & Co., 3408 West Monroe St., Chicago, Ill.—20-page booklet, "The Art of Proportioning," completely describing this company's fluid piston equipment for proportional feeding of solutions.

Sieving. Newark Wire Cloth Co., 351 Verona Ave., Newark, N. J.—6-page leaflet describing this company's testing sieves and power operated sieve shakers.

Steam Generation. Combustion Engineering Co., 200 Madison Ave., New York City—8-page catalog giving specifications and engineering data on this company's small industrial Skelly stoker units; also catalogs BT-5, 34 pages on bent-tube boilers; and VU-1, 12 pages on Type VU steam generators in capacities to 250,000 lb. of steam per hour.

Steam Jets. Graham Manufacturing Co., 220 Delaware Ave., Buffalo, N. Y.—Publication as follows: Catalog and Price List No. 6, 12 pages on steam-jet-operated water coolers; Bulletin 101, single and two stage air ejectors, non-condensing type; Bulletin 102, two stage air ejectors with inter-condensers.

Tools. Beryllium Corp. of Pa., Reading, Pa.—Leaflet concerning promotion of safety through the use of non-sparking tools.

Tubes. Globe Steel Tubes Co., 4030 West Burnham St., Milwaukee, Wis.—Bulletins 301 and 401—Respectively 4 and 8 pages covering seamless steel boiler tubes; and properties and uses of stainless steel tubes of various analyses.

Valves. Homestead Valve Mfg. Co., Coraopolis, Pa.—24-page booklet briefly describing a wide range of quarter-turn valves and blow-off valves made by this company.

Vibrators. Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Bulletin 1833—8 pages on new Utah electro-magnetic feeders and conveyors; leaflet 2247, 4 pages on new Utah electromagnetic vibrating screens.

Welding. Republic Steel Corp., Cleveland, Ohio—Form Adv. 180—20-page booklet illustrating in detail proper methods of welding stainless steel, including fusion, spot, and atomic hydrogen welding as well as brazing and silver soldering.

Wiring. Anaconda Wire & Cable Co., Sales Promotion Dept., 25 Broadway, New York City—Publication C35—32-page industrial guide for the proper selection of wire and cable; also publication 371, 100 pages covering a complete line of wire and cable accessories.

Chemical Engineering NEWS

M.C.A. PLANS EDUCATION PROGRAM FOR CHEMICAL INDUSTRY

POINTING out that millions of Americans have received distorted and misleading information about chemical industry, Harry L. Derby reported that the executive committee of the Manufacturing Chemists' Association has recognized the need for a well-considered program of public education and plans to take constructive action. Addressing more than 200 of the industry's principal executives at the 65th Annual Meeting of M.C.A. at Absecon, N. J., on June 3, he said, "The achievements of our industry and its contributions to the national welfare are so rapid that many chemical producers themselves are not entirely familiar with the progress made in other branches of the chemical industry. We therefore feel that the story of our continuing accomplishments must be told to the American people."

Mr. Derby also urged the industry's cooperation with the Chemical Alliance in supplying data on wages, hours, employment and income in the chemical industry. This information is needed to supplement the figures of the U. S. Department of Labor, especially if the association is called to represent the industry at hearings on the Black-Connery Fair Labor Standards Bill, which is now pending in Congress. Latest official statistics for April, 1937 show hourly earnings in chemical industry of 74.9 cents as compared with 63.7 for all factories and weekly earnings of $30.76 as compared with $26.30. Because of increased seasonal activity, the hours of work in chemical plants have increased to 41.1 per week as compared with 40.4 for all factories.

The executive report cited the outstanding progress of the technical committees, especially in connection with the improvement and development of shipping containers. A new one-time drum having 20-gage side wall instead of the standard 18-gage has recently been thoroughly tested by the Association's committee. If this design receives official approval it will probably result in savings of $1,000,000 a year to purchasers.

Stream pollution is another subject of vital concern to chemical industry, which has now invested more than $3,000,000 in waste-treating equipment and a million more in modifying its processes. M.C.A. members were urged to continue their efforts to eliminate or minimize stream pollution.

President E. M. Allen presided at the meeting which featured an open-forum discussion of executive policies. W. B. Bell of American Cyanamid and Charles A. Higgins of Hercules Powder Co. contrasted the American system of free enterprise and employee relations with those in other countries—especially in Great Britain where there has been longer experience with labor unions. Charles Belknap of Monsanto Chemical Co., C. D. Marlatt of the Martin Dennis Co., Henry Bower of the Bower Chemical Co. and August Kochs of Victor Chemical Co. also participated in this discussion.

"Ethics in Competition" was the subject of a thoughtful paper by Lammot du Pont. He proposed the rule of "reasonableness" in making an impersonal assay of the principal competitive developments that involve ethical considerations.

The association re-elected its present officers: E. M. Allen, president; George W. Merck, and Charles Belknap, vice-presidents; J. W. McLaughlin, treasurer and Warren N. Watson, secretary. Its executive committee was enlarged to include seventeen members which permitted the addition of C. S. Munson, president of the U. S. Industrial Alcohol Co. and R. H. Dunham, president of the Hercules Powder Co. R. N. Chipman of the Chipman Engineering Co. was elected to take the place of Benjamin S. Mechling, representative of the insecticide manufacturers on the executive committee.

At the annual union dinner with the Synthetic Organic Chemical Manufacturers Association, President August Merz first introduced Carl B. Fritsche of the Farm Chemurgic Council who explained what that organization's program would eventually mean to chemical industry. He was followed by Walter B. Weisenburger, executive vice-president of the National Association of Manufacturers, whose illuminating charts of a recent study of public opinion regarding industry thoroughly confirmed the need for the type of educational program which M.C.A. is now sponsoring.

Canadian Chemists Hold Meeting at Vancouver

Members of the Canadian Chemical Association and the Canadian Institute of Chemistry held their annual convention at Vancouver, B. C., June 17 to 19. There was a large delegation from Eastern points, a special train being made up in the East and traveling across Canada to the convention on the Pacific Coast with a stop-off at Trail to visit the Consolidated Mining & Smelting Co. at its huge chemical and fertilizer plants.

The convention got under way on Thursday morning, June 17, with an address of welcome by the mayor of Vancouver. A special feature of the opening session was an address by Prof. James Murray Luck of Stanford University, California, on "Newer Biochemistry in Relation to Human Welfare." At the conclusion of this address a number of technical sessions got under way.

The afternoon of the opening day was devoted to trips to the Fraser Mills, largest lumber mill in the British Empire, and lying some distance beyond the city of New Westminster. On the return trip a visit was paid to the salmon packing plant of B.C. Packers Limited on Lulu Island. In the evening Carl B. Fritsche, managing director of the Farm Chemurgic Council, delivered a lecture on "Chemurgy: A Scientific Solution for Agricultural Problems."

The morning of the second day was given over entirely to technical sessions. In the afternoon a golf tournament was staged at the Hollyburn Ridge Golf Club on the North Shore, across the harbor from Vancouver, and following the tournament the delegates adjourned to Grouse Mountain, where dinner was served at the Chalet overlooking the harbor. Technical sessions again got under way on the Saturday morning, while in the afternoon a sightseeing drive around Stanley Park, Shaughnessy Heights, past Vancouver's famous beaches, and around the sections of the downtown area and Chinatown, was arranged. In the evening the delegates attended the annual banquet and dance which was staged in the Hotel Vancouver, which served as convention headquarters throughout.

Monsanto Chemical Co. Opens New Laboratories in Dayton

ANOTHER mark in the expansion of Monsanto Chemical Co. was reached in the opening of a new addition to its Thomas and Hochwalt Laboratories Division at Dayton, Ohio. The Laboratories merged with Monsanto Chemical Co. about a year ago.

With this new addition, the Thomas and Hochwalt Laboratories constitute one of the most complete industrial research units in the country. The L-shaped one-story structure of reinforced concrete includes fourteen laboratories, two store rooms, instrument room, and air-conditioned offices, library, dining room, and kitchen. Each of the laboratories is well equipped for research along specific lines. The library comprises important periodical and book literature, including complete files of a number of the outstanding chemical journals and current files of some sixty others. One of the most attractive features is the well appointed, soundproofed dining room, providing accommodations for 60 people. Especially striking is the glass brick semi-oval forming one of the sides of the dining room. Three smaller buildings, separated from the main structure, house pilot plant equipment.

The walls of the laboratories are of glazed tile and glass brick. A departure from current practices is the use of square walnut blocks, laid on concrete slab, for all flooring. Indirect lighting is used throughout the laboratories. Architecturally, the whole is a well-planned unit; ample, land-scaped grounds make a fitting background for the white-painted walls of the modernistic building. A picturesque patio separates the two main parts of the laboratory.

On the evening of May 14 the staff of the Laboratories held open house for a group of some ninety guests among whom were Edgar M. Queeny, president, Monsanto Chemical Co.; Charles Belknap, executive vice-president, Monsanto Chemical Co.; Gaston DuBois, vice-president in charge of Development, Monsanto Chemical Co.; Thomas Midgley, Jr., Ethyl Gasoline Corp.; T. A. Boyd, Fuel Research Division, General Motors; Orville Wright; Austin M. Patterson, Antioch College, Henry B. Hass, Purdue University; Walter C. Tredtin, president of University of Dayton; William J. Wohlleben, head of the Department of Chemical Engineering, University of Dayton; Robert A. Kehoe, University of Cincinnati; and Arthur Braden, president of Transylvania University.

During the dinner which was served in the new dining room, Edgar M. Queeny, Charles Belknap, Gaston DuBois and Thomas Midgley, Jr., were the principal speakers. Mr. Queeny spoke of the mutual respect and confidence which prevails among the employees of Monsanto Chemical Co. In this respect, during their existence as an independent unit, the Thomas and Hochwalt Laboratories had fitted into Monsanto tradition so well that the merger of the two organizations came as a natural development.

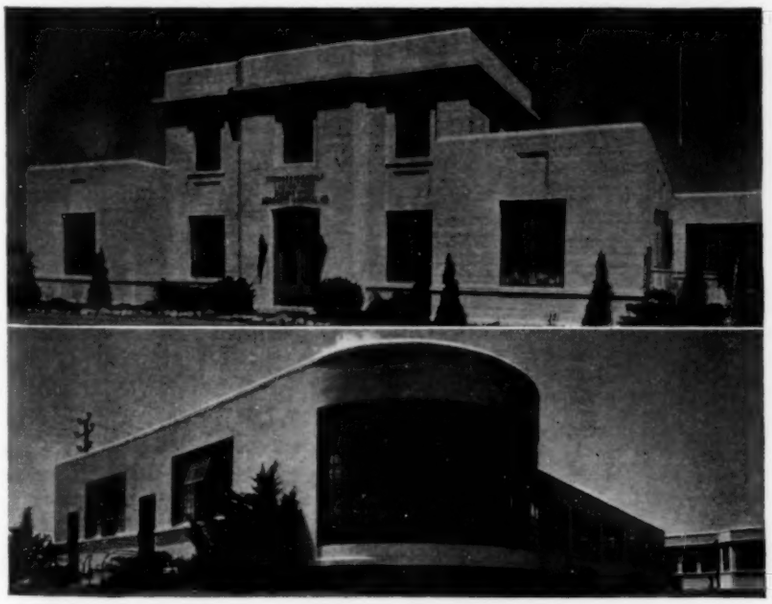
Mr. Belknap, too, spoke of the Laboratories' fitness into the Monsanto scheme. The parent company and the research division are integral parts of effective organization.

Mr. DuBois expressed his confidence in the capabilities of the newly acquired division. As an independent unit it had ably met the challenge of the recent depression; the new research division of Monsanto Chemical Co. was certain to meet coming issues with equal success.

Thomas Midgley, Jr., outlined his long friendship with Charles Allen Thomas and Carroll A. Hochwalt, Directors of the Thomas and Hochwalt Laboratories Division. He stressed the fact that material surroundings do not limit the extent of chemical thought and development. The men, themselves, were more important than the building that housed them. Physical obsolescence of the now very adequate laboratories would indicate only that they had been outgrown.

With a few exceptions, all former associates of Dr. Thomas and Dr. Hochwalt were present at the gathering.

After dinner, the guests were conducted through the various laboratories where Monsanto products in different stages of development were exhibited. The use of apparatus in chemical research was demonstrated by members of the staff, as were also small working models of some actual plant processes. Upon completion of the tour, the guests and the staff met informally in the assembly room.



Front, side, and rear views of new Thomas and Hochwalt Laboratories at Dayton, Ohio

Four Research Appointments Available at Battelle

Four appointments as Research Associate will be available at Battelle Memorial Institute, Columbus, Ohio, for the year 1937-38. Appointments are for September to August inclusive. These appointments are open to graduates of any accredited university or college. Preference will be given to men who have completed one or more years of graduate study in chemistry, physics, metallurgy, fuel technology or ceramics; or who have demonstrated marked aptitude for scientific research in their industrial experience.

Appointments as Research Associate will be for one year's duration, including vacation, and may be extended for a second year. The salary will be from $1200 to $1800 a year, depending upon the training and experience of the individual.

Visitors to Achema Will Find Open House at Frankfort Consulate

By PAUL WOOTON
Washington Correspondent
McGraw-Hill Publications

REPRESENTATIVES of the American chemical industry about to leave for the important exhibition of chemical machinery, apparatus and equipment in Frankfort-on-Main next month will find the American consulate-general at Frankfort of particular interest at this time. It is principally through this office that the American industry keeps in touch with the developments in Germany's chief chemical center.

Every member of the American delegation to Achema VIII, as the exposition is known, is destined to become very well acquainted with George A. Makinson, the consul general, and Sydney B. Redecker, the chemical specialist, who serves as consul. Their knowledge of Germany's chemical industry is profound and ably assisted by their respective wives they are notable dispensers of hospitality.

The writer was in Frankfort in March and had an opportunity to appraise the work being done at this consulate. Mr. Makinson and Mr. Redecker have been important factors in convincing the executives of German chemical establishments that there is more to gain through the exchange of ideas than there is through a policy of working behind closed doors.

Ever since its re-establishment after the World War, the Frankfort consulate-general has been active in reporting upon developments in the German chemical and metal industries, in the interest of American commerce and industry and expansion of German-American trade relations. However, it has only been since 1931, when Mr. Redecker was assigned by the Department of State to Frankfort for specializing in this particular work that it has been developed on the present systematic and intensive scale.

George Makinson
Consul General at Frankfort-on-Main

For some years the consulate-general has served as principal agency of the United States Government for reporting upon German chemical and metal economics, and under the existing Foreign Service practically all requests from government branches, as well as inquiries received by other government offices in Germany from private business concerns, for information upon these subjects, are referred to that office for the required information.

In 1936 the consulate-general submitted a total of 399 official reports relating to chemical and metal subjects. In 1935 a total of 427 such reports were made. These were in addition to a large number of reports on other trade subjects. Reports range all the way from very brief half-page contributions, regarding some new process or incidental development, to comprehensive basic reviews discussing in detail the industry in its entirety. The annual review "The German Chemical Industry

Top—Headquarters of I. G. Farbenindustrie Aktiengesellschaft at Frankfort-on-Main
Bottom—View of Exhibits at Achema VII

Sydney B. Redecker
Consul at Frankfort-on-Main

in 1936," embracing 110 legal-size sheets, and "Germany's Program of Motor Fuel Production," 64 pages, are two examples.

In addition to official reports the consulate-general conducts an extensive correspondence directly with individual American concerns resulting from inquiries received from them for information regarding specific subjects.

The consulate-general also extends assistance to representatives of American companies visiting Frankfort in person for developing their relations with German concerns, for either the purchase or sale of materials and processes. This assistance includes the making of special trade studies along the lines of the visiting business executive's particular needs, the placing at his disposal of all pertinent data available, the giving of information regarding outside sources of information for the executive's independent investigation, the arranging of interviews with local business executives.

The consulate-general, by its intensive research and reporting activities extending over a period of so many years, has built up elaborate reference archives which are of great value in providing basic data and background enabling it to supply a great deal of pertinent information regarding innumerable important economic developments and trade subjects from its own independent resources and facilitating the conducting of any supplementary outside investigation required for building up a complete and accurate picture of latest developments and the current situation.

The consulate-general is strategically situated for conducting its specialized chemical trade report work owing to Frankfort's status as "Germany's Chemical Capital" in which some of the largest and most renowned German chemical companies have their headquarters. This enables the consulate-general to maintain close contact with these important units of the German industry. The entire Rhine-Main economic district, of which Frankfort is the nucleus, is outstanding because of having been the center of origin of the early German dye industry where a very substantial share of the national chemical output is still concentrated, notwithstanding later large-scale production developments in other districts, notably Central Germany in the region of Merseburg, in Bavaria, and in the Ruhr district.

Chief among leading chemical and metal concerns having their seats in Frankfort are the I. G. Farbenindustrie A. G., Germany's famous chemical colossus, popularly known as the "German Dye Trust" and "German Chemical Trust," credited with controlling around 35 per cent of the national chemical output; the Metallgesellschaft, dominant factor in the German non-ferrous metal industry with important interests in the chemical sphere also, especially in chemical-engineering through its subsidiary "Lurgi" companies; and the Deutsche Gold-und Silber Scheidenanstalt A. G., possessing a virtual monopoly of the precious metals industry with important and steadily expanding chemical interests. Among other notable companies in this district is E. Merck, with headquarters in Darmstadt, 28 kilometers to the south of Frankfort, widely known for its extensive line of pharmaceutical preparations and fine chemicals and particularly rare medicinal specialties. All of these large concerns maintain close relations with the United States and nearly all have important subsidiaries or branches in this country.

The Achema Annual for 1937 has recently been published. It is a profusely illustrated book of 388 pages and reviews and catalogs practically all the products for scientific and industrial products which will be shown at the Achema VIII Chemical Engineering Exhibition. Its usefulness as a guide to the visitor is accentuated by the fact that the multitude and variety of the apparatus, plant equipment, machines and accessories to be exhibited require the space of seven halls with an area of 175,000 sq. ft.

The Annual is supplied free of charge to those who have registered their visit to the Achema VIII in advance. Only three international reply coupons need be sent to cover postage. Prospective visitors to the Achema VIII may now register in advance at the Dechema German Society for Chemical Engineering, 103a Potsdamerstrasse, Berlin W. 35.

It also is announced that the regulations of the German Railroad System governing the reduction of fare for foreigners to 60 per cent of the regular fare have been amended as of May 13 to the effect that visitors from other countries need no longer stay a minimum period of seven days in Germany in order to get the benefit of the reduced fare.

IMPERIAL CHEMICAL INDUSTRIES REPORTS RECORD INCOME FOR 1936

From Our London Correspondent

At its annual meeting Imperial Chemical Industries, Ltd., announced a record gross income of £9,049,422. After providing £1,000,000 for obsolescence and depreciation and £846,093 for income tax, net income for 1936 amounted to £7,203,329. This is the first occasion that the net profit of the company has exceeded £7 million. With a final dividend of 5½ per cent on the ordinary stock, the full distribution has been maintained at 8 per cent for the third year in succession.

Lord McGowan, who presided at the meeting, laid stress on the fact that I.C.I. had consistently maintained a policy of intensive research, which was not only directed to the development of new products and new manufacturing processes, but also to the improvement of existing processes and the discovery of new uses for existing products.

Chemical Engineering NEWS

Speaking in particular about the petrol plant at Billingham, Lord McGowan stated that the plant had not shown results which would allow it to be considered a commercial proposition, nevertheless the company was convinced that it had taken a good step when it embarked upon the hydrogenation system for converting coal into motor spirit without creating by-products.

Increase in alkali manufacture was mainly due to the demands of the British glass and rayon industries; this had necessitated the reconstruction of certain alkali plants and the extension of others. Business in the dyestuffs group had expanded at the same rate as it did during the previous year, and here again, with an additional demand from the home and overseas market,

particularly India, the manufacturing plants had been continuously under a policy of being modernized. In the general chemicals groups the sales of chlorine products had made notable progress, and the demand for mineral acids had improved; trade in organic acids, however, remained steady.

Modernization of the I.C.I. sulphuric acid plant at Widness is making progress, and additions are being made to give a greater capacity for high strength acid; a new acid plant is also under construction at Oldbury, where a new salt cake and hydrochloric acid plant has been in operation for the greater part of 1936. Plant for sodium manufacture, using a process new to the United Kingdom, is under construction at Billingham. Several plant developments are also reported in connection with I.C.I. activities overseas.

A new type of synthetic rubber has been exhibited in London by Imperial Chemical Industries Ltd. Introduced under the name of Neoprene, this polymerized chloroprene is used for purposes where natural rubber is wholly or partially unsuitable. In particular, Neoprene has a high resistance to ozone and ultra-violet radiations, is less affected by chemicals and is less permeable to gases than rubber, and does not soften under the influence of heat. Its oil resistance, which applies to lubricating oil and all kinds of animal, vegetable or mineral oils, is about five times that of rubber. Neoprene should therefore find special application in the manufacture of gaskets, washers and packings for various industrial purposes. By admixture with natural rubber a flexible non-brittle ebonite is obtained, and this product has an equally good resistance to oil and chemical attack. A successful use in the chemical industry in the form of acid buckets, pipes and similar plant accessories is predicted in addition to which the hardened Neoprene will also find use as a protective coating for centrifugal baskets and as tank linings.

A plan for establishing a calcium carbide industry in North Wales has been submitted to the Government. The site of the proposed works is at Llanerch-y-Mor, on the estuary of the river Dee. Within a radius of 100 miles from this site there is said to be a normal annual demand for 20,000 tons of carbide. Transport facilities for the supply of anthracite from South Wales are favorable; limestone will be drawn from quarries in the Halkyn mountains. In addition to carbide, an annual yield of about 28,000 tons of carbon dioxide is estimated, and a plan is being considered for marketing this gas in solid form for use as a refrigerant. Sir Gilbert Morgan, director of the Chemical Research Laboratory, Teddington, has been appointed technical adviser to the Government Committee which is considering this important matter.

Monsanto Chemicals Ltd. is completing an extension to its synthetic phenol plant at Ruabon, North Wales. Fison, Packard and Prentice, Ltd., sulphuric acid and super-phosphate manufacturers, of Ipswich, is acquiring a considerable part of the share capital of the Anglo-Continental Guano Works Ltd., and this may ultimately lead to some new developments in the manufacture of fertilizers.

The South Kirkby, Hemsworth and Featherstone Collieries Ltd., are to erect an important plant at Hemsworth Colliery to work up the products of 4,000–5,000 tons of coal per week. A battery of 32 Still regenerative coke ovens, together with coal and coke handling equipment and complete by-product plant, are at present under consideration for the Dinnington Coking Co. Ltd. Still regenerative ovens, to the number of 24, are also being erected at the site of the Maritime Works of Powell Duffryn Associated Collieries Ltd.

SYNTHETIC GASOLINE PLANTS DRAW HEAVILY UPON GERMAN COAL SUPPLIES

From Our German Correspondent

As further synthetic gasoline plants are established in Germany, discussion has arisen as to what percentage of the annual coal output should be used for making synthetic motor fuels, and it is believed that an agreement has been concluded. Some experts propose that as much coal as possible be used, while others feel that its use should be restricted, especially in view of the fact that mine-head stocks are at an unusually low level. Germany's reserves to a depth of 1,000 meters, according to the latest survey of the Prussian Geologic Board, would suffice for 500 years for coal and 400 years for lignite if annual production were 150 million tons each per year.

At first the synthetic plants were partly justified as a military preparedness measure, but of late this reason has been open to some criticism. In the "Deutsche Volkswirt" military experts estimate that for the larger European powers war-time requirements for motor fuel would be from 10 to 20 million tons annually. H. Steinberger has calculated that it would cost 4 billion marks to build hydrogenation plants capable of producing 12½ million tons of synthetic motor fuel, and it would require 250,000 men to run them. At least 100,000 men would be required to mine the necessary coal alone. This, it is felt, would signify too large a loss of available man-power for the front line operations. The vulnerability of large hydrogenation plants and oil tanks in case of air raids is also considered a handicap, and as a result, the possibility of using old abandoned mine shafts for storing motor fuel underground is being considered.

With the latest 5 per cent bond issue of Dessauer Gas, the total of new capital of west German mining interests engaged in synthetic production has been raised to 188 million RM. The latest establishment is the Union Rheinische Braunkohlenkraftstoff A.G., Cologne, which plans a high-pressure hydrogenation plant for gasoline and diesel oil at Wesseling on the Rhine. The Schaffgottsche Benzin Gm.b.H., Gleiwitz, has been founded to establish a local plant utilizing Upper Silesian hard coal mined by the Schaffgottsch concern.

Rights to use the Fischer-Tropsch synthesis have recently been secured by the "Anglo-Transvaal Consolidated Investment Co., Ltd.," which plans to erect plants soon in South Africa.

Since synthetic motor fuel is not considered the final solution to Germany's motorization problem, considerable research is being done with new engines which will permit the direct utilization of coal or wood. A stationary dust diesel, or "Rupa," motor developed by Rudolf Pawlikowski in Silesia is attracting considerable attention since it has been operating at a cost 94 per cent cheaper that that of a gasoline engine.

The Benzol Verband has initiated a policy of distributing only German made light motor fuels. Besides the benzol-benzine mixtures this large distributor now markets German coal gasoline under the Trade name of "Bevaulin."

Both the motor fuel and alcohol industry are affected by a decree of April 21 of the ministry of finance regarding "Treibsprit," the alcohol admixture for gasoline. The decrees concerning the compulsory admixture of "monopoly spirits" (etheyl alcohol) to help consume the Reich alcohol monopoly's production, which has been in effect for some years, have been changed again to permit a mixture of methanol in the ratio of 1 : 2 instead of 2 : 8. Since methanol is cheaper than ethyl alcohol the price of "Treibsprit" will probably be reduced to 40 RM per hectoliter. This measure will cut down the production of alcohol from potatoes and make larger supplies of potatoes available for nutrition purposes.

A new raw material decree requires that domestically produced benzol must have all toluol removed so that the latter can be used for other purposes.

PROCESS industry will not be fundamentally affected in most cases by wage and hour standards prospectively to be fixed if the Black-Connery labor standards bill should become law. Chemical industries have generally paid higher wages than the minimums likely to be fixed. And there is no probability of hours regulation requiring shorter work weeks than now generally prevail in chemical industry plants.

This legislation does, however, raise the old fundamental question of Washington dictation on industry's problems. It out-deals the New Deal of Blue Eagle days. If this legislation is enacted, even in much curtailed and modified form, the Federal Government will have stepped in to control intimate details of manufacturing, merchandising, mining, and other business that most chemical engineers believed, until quite lately, to be indisputably a matter of state, not federal control.

Presidential Prestige

The President suffered a set-back in the defeat of his Court-packing measure. Leadership by the Chief Executive in fiscal matters was more than questioned by the House of Representatives in its consideration of the relief appropriation bill. Unfortunately, the motive was altogether home politics, personal political fence building. It did not have a set of "moral principles" to support it, and the ultimate victory of the President in getting generous relief allowances, not unduly restricted by either legislative dicta or private promises, was inevitable.

Congress has ceased to be a rubber stamp ready at hand for Presidential use. But Washington does not believe that either Representatives or Senators have yet resumed their constitutional prerogative of deciding legislative policies. The President may still, by suitable political manipulation, muster a majority for almost any measure which he wants badly enough to work for.

Delay in relief appropriations and defeat of the Supreme Court measure constituted revolt by party members not observed previously since 1932. But the President still leads; and he largely bosses what goes on on Capitol Hill. This is important to remember when judging the prospect for any legislation.

Helium Prospects

Destruction of the Hindenburg at Lakehurst has unquestionably postponed to the indefinite future the resumption of lighter-than-air plans for Army and Navy. The fact that the disaster might not have occurred with a helium-filled ship does not greatly reduce its influence in this direction.

Washington apparently believes that some mechanical defect ruptured a hydrogen cell, and that the escaping gas

NEWS FROM WASHINGTON

Washington News Bureau
McGraw-Hill Publishing Co.
Paul Wooton, Chief

was set fire by frictional or static electricity generated within the ship itself. Dr. Eckener's explanation that a stay-wire may have been broken during the strain of landing is probably as good a guess as anyone can make. The ease for generation of static charges by rubber-to-rubber, rubber-to-metal, or even gas-to-rubber, friction would easily explain the ignition if one knew that flammable mixtures had been formed within the outer envelope.

A new international question now confronts Washington. Congress and executive officials would be quite willing to allow American helium to be supplied in reasonable quantities to a German commercial unit, if this could be done without seriously depleting American reserves, which seems likely. It would permit the stimulation of commercial production, or perhaps even the low-cost operation of the Government-owned helium unit at Amarillo. Such a regular customer would be very welcome to all producers, Governmental and non-governmental alike.

But there are those that believe helium so furnished would be diverted into a military reserve. This suspicion may well have sufficient influence to preclude authorization for furnishing helium for international aircraft usage. In early June it is anybody's guess what Congress would do if this question came up for vote. The chances are it will not be pressed to vote, unless the proponents feel reasonably sure that the wanted authority will be given.

Tariff Changes

Under the guise of administrative revision, rather an extended overhauling of some features of the present Tariff Law is in progress. This is an Administration measure, and is expected to pass. Although the changes nominally relate to marking, containers, penalties, administrative exemptions, and procedure, many of the modifications, if enacted, will largely affect import practices. Some of the importers feel that among the modifications are new restrictions which might be prohibitively costly with respect to some commodities should they ever achieve the unenviable position of debatable in classification.

One recent change made by Treasury decision a few weeks ago, clarifies the "country of origin" for imports. Entries must now clearly indicate the real country of origin, not merely the country from which import sale or invoice took place. Officials hope that this change will enable more accurate goods classification, and therefore a better appraisal of certain economic trends.

Export Rules

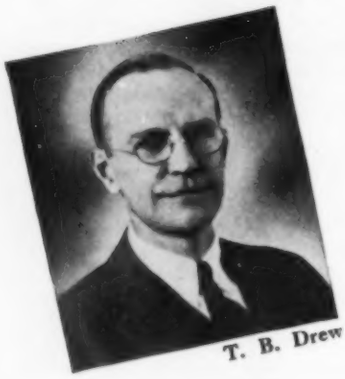
Affecting exports of goods classified as implements of war, a proclamation during May described an enlarged list of equipment and chemicals. There now are approximately twenty toxic or related "poison" gases and nearly as many explosives definitely covered by the rules of export license. Domestic manufacturers of these goods, whether exporters or not, are required to register with the State Department.

The battle over the question of export of scrap metal continues. Actual commercial considerations are more important than political. American metallurgical enterprises do not like to have foreign steel makers given cheap scrap from which steel can be made more economically than from ore. To do so merely accords commercial advantage to foreign steel enterprises whenever they meet American metal or machinery companies in the world market.

Washington is beginning to discover what aid to the commercial enemy has been accorded for many years by slovenly political approach to these economic questions. It remains doubtful whether there are enough votes available to secure enactment of the needed remedial legislation. Unless the votes appear, the economic need will not be adequate to secure enactment.

Assistance to the chemical industries by foreign Governments was one of the marked developments in 1936, according to information reaching government officials in Washington, with the result that American chemical producers found that they had more competition to meet than in the preceding year, when they encountered German competition in certain world markets. Many foreign governments established control over the industry to limit expansion and restricted imports and also tightened regulations governing sales and advertising, while chemical research was broadened, with the idea of obtaining national self-sufficiency along a number of chemical lines. Japan is reported to be the leader in the introduction of new chemical products, as well as in construction of new plants, and the expansion of old ones.

PERSONALITIES



T. B. Drew

J. H. Rushton

A. S. Elsenbast

E. S. Stateler

✦ THOMAS B. DREW, chemical engineer at the Wilmington, Del., experimental station of E. I. du Pont de Nemours & Co., received the William H. Walker Award from the American Institute of Chemical Engineers at its recent annual meeting in Toronto. Conferred annually in recognition of the best technical paper published in the Institute's *Transactions*, the award went to Mr. Drew for his publications in the field of fluid flow and heat transfer.

✦ JOHN H. RUSHTON has been appointed head of the department of chemical engineering at the University of Virginia, succeeding the late Alfred McLaren White. He will resign his present position of assistant professor of chemical engineering at the University of Michigan and will begin his new duties in September, 1937.

✦ ARTHUR S. ELSENBAST, manager of the filter aids and filler department of Johns-Manville, has been appointed vice-president of the Johns-Manville Sales Corp. Mr. Elsenbast has been in charge of the development of diatomaceous earth products for twenty years, first with the Celite Co. and later with Johns-Manville.

✦ E. S. STATELER, associate editor of *Food Industries* and former Mellon Institute fellow, has been transferred to the Chicago office of the McGraw-Hill Publishing Co. There his duties will include editorial representation of *Chem. & Met.* in the Mid-West.

✦ WALTER L. BADGER has resigned as professor of chemical engineering at the University of Michigan to become manager of the Dow Chemical Co.'s consulting engineering division with headquarters at Ann Arbor, Mich. His resignation, which takes effect July 1 and severs all official connection with the University, will terminate a distinguished teaching career of 25 years at Michigan.

✦ JAMES LEWIS HOWE, dean of the school of applied science and head of the department of chemistry at Washington and Lee University, has been awarded the Herty medal by the American Chemical Society for his outstanding contributions to chemistry in the South. Dr. Howe has been active in southern education for over 50 years and has contributed greatly to our knowledge of the platinum metals.

✦ THEODORE J. KREPS of Leland Stanford University sailed on May 19 to represent the United States at the meeting of the International Labor Organization in Geneva. The purpose of the meeting is to consider labor problems of the chemical industries, particularly with regard to the possibility of arriving at an international agreement on hours and rates.

✦ MELVILLE VAUGHAN, formerly chief chemist at the Pioneer Asphalt Co.'s plant in Lawrenceville, Ill., has joined the technical staff of Continental Carbon Co. in its new central laboratory in New York City.

✦ FREDERIC W. WILLARD has been elected president of the Nassau Smelting and Refining Co. and subsidiary companies. Mr. Willard developed some of the alloys and insulation materials used extensively in the communications field.

✦ THOMAS C. OLIVER, has resigned the vice-presidency of Chemical Construction Corp., of which he was one of the founders, to devote his time to Charlotte Chemical Laboratories, Inc., Charlotte, N. C., and other technical projects in which he is interested.

✦ P. H. EMMETT has resigned his position at the fixed nitrogen research laboratories of the Bureau of Chemistry and Soils to join the staff of Johns-Hopkins University as professor of chemical engineering.

J. L. Howe

Gustav Egloff

J. F. Norris

C. C. Monrad

✦ GUSTAV EGLOFF, director of research for Universal Oil Products Co., is in Paris, France, officiating as vice-president of the Second World Petroleum Congress.

✦ MARTIN HILL ITTNER, A.I.Ch.E. president, received a unique pair of honors this month. Washington University of St. Louis presented him with an L.L.D. degree June 8. A son, Robert Austin Ittner, was born June 7.

✦ KENNETH M. HENRY, for some years plant manager of Owens-Illinois Pacific Coast Co. in San Francisco has moved to Toledo, Ohio to participate in research work for the parent company. His place in San Francisco is to be filled by R. H. OLSON.

✦ CLARK C. HERITAGE, recent president of the Technical Association of the Pulp and Paper Industry, has resigned his position as technical director of the Oxford Paper Co., Rumford, Me., to join the Wood Conversion Co. at Coquet, Minn., as development engineer.

✦ P. B. STULL has been placed in charge of the Paper Makers Chemical Division of the Hercules Powder Co., filling the vacancy left by the resignation of W. J. Lawrence. Mr. Stull's former position of general manager of the Virginia Cellulose Department of the company will be filled by LLOYD KITCHEL.

✦ ANTHONY ANABLE, of the Dorr Co., Inc., has been elected a member of the Alumni Council of the Massachusetts Institute of Technology for the two-year term beginning in July, 1937.

✦ FRANK SCHNEIDER, Ph. D., Rutgers University, 1936, has been appointed to a teaching fellowship in chemistry at Trinity College, Hartford, Conn. He will give one or two advanced courses and will carry on research with the help of advanced students.

✦ JAMES F. NORRIS, professor of organic chemistry at Massachusetts Institute of Technology, has been awarded the medal of the American Institute of Chemists in recognition of outstanding service as a teacher and as an investigator in the field of atomic and molecular reactivity in organic compounds.

✦ DONALD M. WELCH, formerly of the Mansfield Rubber Tire Co., has accepted a position as rubber chemist in the Continental Carbon Co.'s laboratories at Sunray, Texas.

✦ EARL G. STURDEVANT has been appointed consulting engineer of the electrical wire and cable department of United States Rubber Products, Inc.

✦ FREDERICK H. RHODES, for many years associated with E. I. du Pont de Nemours & Co., is now conducting a development program in synthetic resins for the Neville Co., Pittsburgh. Mr. Rhodes is making his headquarters in New York City.

✦ EDGAR S. DAUGHERTY has been appointed head of the heater division of the water conditioning and purification department of the Cochrane Corp.

✦ JAMES R. HARRINGTON, formerly with the titanium division of National Lead Co., has been appointed to the New York office of the Mathieson Alkali Works.

✦ E. E. WRIGHT has been put in charge of the Cleveland office of Electro Metallurgical Sales Corp., a unit of Union Carbide and Carbon Corp.

✦ L. W. KNAPP, until recently with the Taintor Co. of Bayonne, N. J., has joined the sales engineering staff of Oliver United Filters, Inc.

✦ ELON H. HOOKER, president of the Hooker Electrochemical Co., has been elected chairman of the National Industrial Conference Board.

✦ CARL C. MONRAD has accepted the position of associate professor of chemical engineering at Carnegie Institute of Technology, Pittsburgh. His appointment will become effective this fall. For the past seven years Dr. Monrad has been with the research department of the Standard Oil Co. of Indiana.

✦ FREDERICK MARK BECKET, president of Union Carbide and Carbon Research Laboratories, Inc., and vice-president of the Electro Metallurgical Co. and the Union Carbide & Carbon Corp., has been awarded the Acheson medal by the Electrochemical Society.

CALENDAR

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting, Waldorf-Astoria Hotel, New York City, June 28 to July 2.

ACHEMA VIII, German chemical equipment exposition, Frankfort-on-Main, Germany, July 2-11.

AMERICAN CHEMICAL SOCIETY, semi-annual meeting, Rochester, N. Y., September 6-10.

CHICAGO EXPOSITION OF POWER AND MECHANICAL ENGINEERING, International Amphitheater, Chicago, Ill., October 4-9.

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY, fall meeting, Savannah, Ga., October 18-20.

16TH CHEMICAL EXPOSITION, Grand Central Palace, New York City, December 6-11.

AMERICAN CHEMICAL SOCIETY, semi-annual meeting, Dallas, Texas, April 18-21, 1938.

Chemical ECONOMICS and MARKETS

CHEMICAL OUTPUT MAKES NEW RECORD FOR SOME PRODUCTS

MANUFACTURING activity increased by more than the normal seasonal amount during April, setting a new seven-year record, according to a report of the Federal Reserve System.

A slump in bituminous coal production offset the gain in manufacturing and the board's combined index of "industrial production" remained unchanged from March at 118, based on the 1923-25 average as 100, or "normal." In April, 1936, the index was 101. For manufacturing alone, the index also was 118, compared with 117 in March and was higher than in any month since the Fall of 1929.

Iron and steel and automobile production contributed the largest portion of the gains in manufacturing activity from March to April. Production in both these industries continued in the first three weeks of May to hold to the April level, according to the board. The food and tobacco products industries were the only other ones to show larger than seasonal gains.

Textile and shoe output showed a decline considerably larger than is normal. Bituminous coal production in April was only about half the March total. Production of lead, zinc, crude petroleum and anthracite increased.

The board also noted a decline in wholesale prices between the middle of April and the middle of May. A larger than seasonal gain in building activity, due principally to residential construction, was reported.

Latest available statistics show that all branches of the textile industry have operated at a high rate for the first four months of this year. Rayon production was held down somewhat in the last month due to labor troubles but new plant capacity is enabling the industry to stay ahead of last years record and consuming demand is fully up to the productive rate.

Consumption of raw wool averaged 5,796,000 lb. weekly (scoured basis) in April, against 6,582,000 pounds in March, a decline of 11.9 per cent, it is reported by the Department of Commerce. The March figure was one of the largest in recent years. Receipt of new business has been light for several weeks, however, and in view of this situation a dip in manufacturing activity has been expected. As compared with a year ago, when a sharp decline was in progress, there was a gain of 41 per cent, consumption having averaged 4,111,000 lb. a week in April, 1936.

Consumption of crude rubber during April declined to 51,797 long tons from 54,064 in March, according to estimates by the Rubber Manufacturers Association. Although one of the largest manufacturers in the industry, was closed during the period consumption of crude rubber dropped less than one-half of one per cent below the consumption in April of last year, when it totaled 52,031, long tons.

Total absorption of crude rubber and reclaimed rubber combined during April amounted to 66,603 long tons, compared with 62,364 long tons in April, 1936. This gain was due to the substantial increase in the use of reclaimed rubber.

In the glass industry a high rate of activity was held through April. April production of window glass was 1,330,893 boxes which represents 81.9 per cent of the total capacity. Production of plate glass in April set an all-time high for the industry and despite closing of plants in January the four-month output this year exceeded that for the corresponding period of last year.

Glass containers have felt the stimulus of larger consuming markets and production for the year to date is running close to 30 per cent ahead of that for 1936.

The National Fertilizer Association reports that April was the fourth consecutive month in which superphosphate production was substantially in excess of the corresponding month of the preceding year, according to reports by acidulators to The National Fertilizer Association. Output during the month exceeded 1936 by 68 per cent and was the largest recorded for any April in several years. Tonnage output in the first four months of this year was more than 50 per cent larger than in January-April 1936.

Although shipments of superphosphate had been at an unusually high level in earlier months there was no letdown in April. Shipments to mixers in past years usually reached a peak in March, followed by a downward trend until mid-summer.

The higher rate of operations this year at steel mills is reflected in the larger output of byproduct coke which in turn accounts for a larger production of coal-tar products. Reference to the accompanying table shows the extent of the increase in the outputs of benzol and ammonia, the latter being the sulphate equivalent of all forms produced at byproduct coke plants.

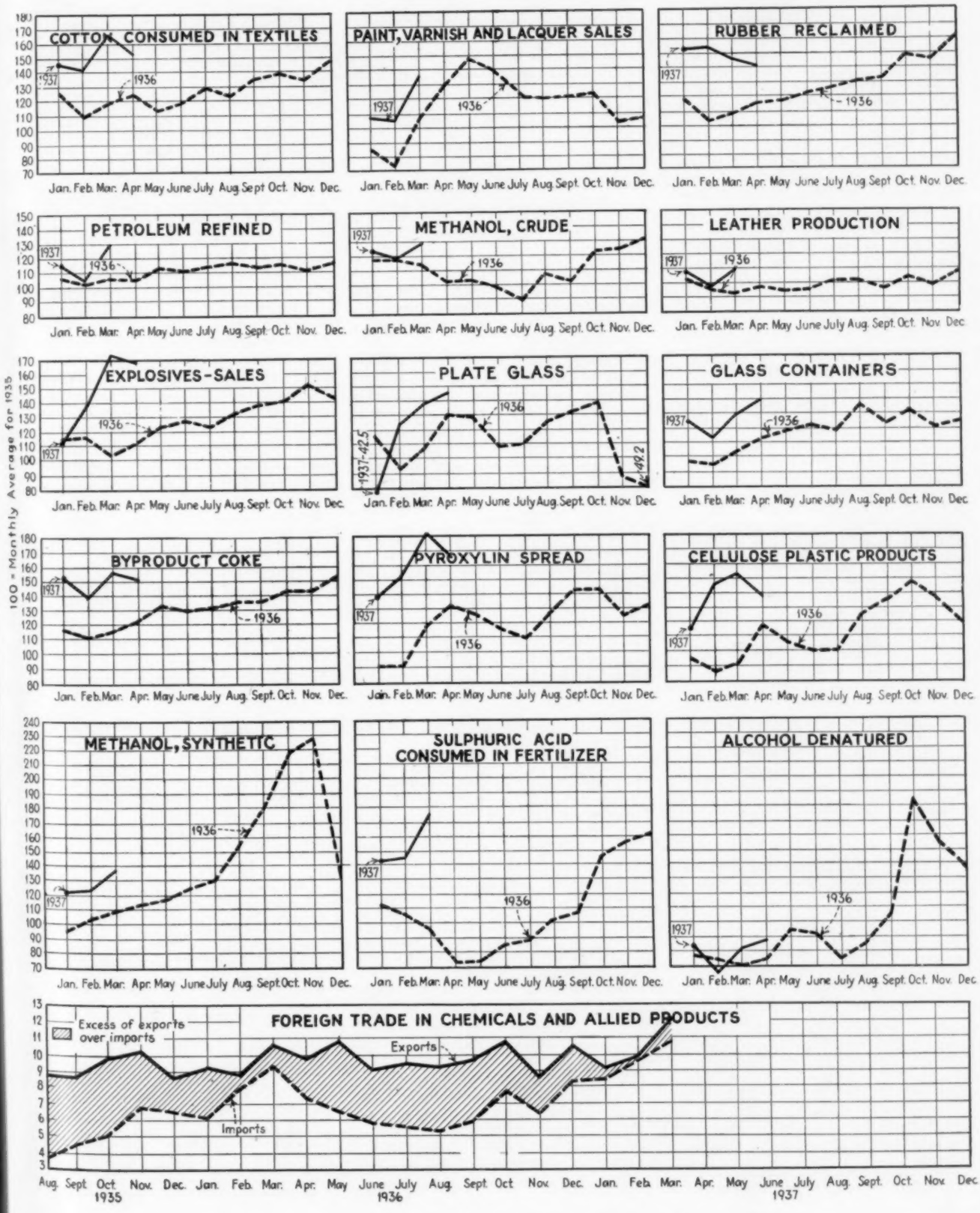
The rate of general manufacturing activity has declined somewhat in the last few weeks and seasonal influences may bring about a further decline throughout the next two months but the chemical industry is reported to have experienced but little slackening and many plants are said to be holding an even operating rate.

From the data on consuming industries which is now at hand, it is evident that new records have been made in the production of some chemicals for the year to date.

	April, 1937	April, 1936	Jan.-April, 1937	Jan.-April, 1936	Gain for 1937 per cent
PRODUCTION					
Alcohol, denatured, 1,000 wi. gal	7,105	6,047	25,934	23,886	8.6
Ammonia, tons *	69,820	55,212	274,971	208,980	31.6
Automobile, No.	536,334	502,674	1,744,652	1,575,080	10.8
Benzol, 1,000 gal.	10,328	8,543	40,956	31,453	30.2
Byproduct coke, 1,000 tons	4,348	3,466	17,193	13,174	30.5
Cellulose acetate plastics, 1,000 lb.	1,411	1,221	5,155	3,473	48.4
Nitrocellulose plastics, 1,000 lb.	1,692	1,388	7,177	5,164	39.0
Glass containers, 1,000 gr.	4,543	3,604	16,660	13,104	28.7
Plate glass, 1,000 sq. ft.	21,956	19,455	67,748	66,645	1.7
Methanol, crude, 1,000 gal.	532	426	2,104	1,891	11.3
Methanol, synthetic, 1,000 gal.	2,139	1,693	7,896	6,284	25.6
Pyroxylin spread, 1,000 lb.	7,156	5,647	27,422	18,613	47.3
Rosin, wood, bbl.	61,742	54,209	241,377	210,384	14.7
Turpentine, wood, bbl.	9,840	8,662	38,373	35,024	9.6
Rubber reclaimed, tons	13,884	11,382	58,667	43,947	33.5
CONSUMPTION					
Cotton, 1,000 bales	719	577	2,840	2,234	27.1
Silk, bales	40,561	.....	163,177	141,612	15.2
Explosives, sales, 1,000 lb.	41,870	27,483	140,874	100,214	40.5
Rubber, crude, tons	51,797	52,031	204,887	180,096	13.8
Paint, varnish, and lacquer, sales, $1,000	44,562	36,209	142,380	110,106	29.3
Sulphuric acid in fertilizers, tons	172,936	81,921	698,270	432,300	61.5

* Sulphate equivalent of byproduct coke production

TRENDS OF PRODUCTION AND CONSUMPTION



HIGHER PRICES ANNOUNCED FOR FORWARD DELIVERIES OF AMMONIUM SULPHATE

WHILE different reports have been in circulation regarding the probability of higher prices going into effect on some of the more important chemicals, the only important revision is found in the case of ammonium sulphate for which higher prices have been announced. The position of nitrate of soda has been strengthened and it is possible that it likewise will be marked up in price for later deliveries. Sulphuric acid has been firmly held for some time and spot trading in this material has gone through at prices higher than were in effect a year ago. Stocks have been low but with fertilizer demand tapering off, this condition may be improved during the summer months.

Some of the coal-tar chemicals have been moving in an active way and have commanded better prices. This has especial reference to cresol and cresylic acid, the limited stocks of the latter acting as an important factor in increasing values. Pyridin also is in small supply and sales prices are strong accordingly. On the other hand offerings of naphthalene have increased in recent weeks with foreign offerings available in a larger way.

Paint and varnish manufacturers are reported to be operating in an active way but are well covered on their raw material requirements and the spot market is not reflecting the rate of manufacturing. Carbon black is moving in a large way from manufacturing center with the rubber trade taking the greater part of shipments.

Stocks of crude cottonseed oil have been well absorbed and prices are largely nominal and will continue so until new crop oil comes on the market. Linseed oil has moved out well on existing contracts with no important price developments. Resale oil has been offered at times but crushers have not changed their views and probably will not do so until it is possible to get a better line on the extent of seeding in the northwestern states. Argentine seed has been arriving in this country in good volume and has been delivered to western mills as well as to crushing plants along the seaboard. China wood oil has been offered at lower prices following the trend at distributing centers in the Far East.

Foreign trade in chemicals and related products has held up well both as regards incoming and outgoing shipments. Exports in April according to preliminary figures reached a valuation of $12,437,000 as compared with $9,837,000 for April 1936. For the same month imports are reported at a value of $11,025,000 in contrast to $7,313,000 for April of last year.

In a survey of the world chemical industry for 1936, the Department of Commerce stated that the devaluation of currencies in the gold-block countries had little effect for the most part on chemical business during 1936 since most contracts had been made far in advance of current needs. Ample supplies, therefore, were readily available at old price levels and prompt Government intervention prevented a too rapid rise in chemical prices in those countries.

In foreign chemical markets, so far as the United States was concerned, competition in 1936 from Japanese and Russian products was not as important as in 1934, except in a few isolated instances, but Germany did succeed in obtaining a larger share of the business in certain areas. To site specific cases, in the Far East, especially in British Malaya, a feature of the acid and industrial chemical market was reported to be Japanese competition, with prices 40 per cent under those quoted by other foreign suppliers; while sizeable shipments of calcium arsenate were received in Peru from Japan. Germany successfully penetrated Central and South American markets, and in Guatamala and Honduras, in particular, its position was much stronger, with appreciable sales of fertilizers and other agricultural chemicals being recorded.

Among developments in foreign markets are: As a result of the Spanish revolution that country's position as a supplier of pyrites is being seriously threatened, according to reports reaching the Commerce Department.

At a recent meeting the chairman of a British company which operates mines in Spain stated that Spanish pyrites is losing the trade not only temporarily but probably for years to come as producers in other countries, notably Portugal, Scandinavia, and Yugoslavia are closing long term contracts with Spain's former customers.

After the initial period of expansion Germany's output of dry ice has remained at approximately 1,500 metric tons per annum during the past three years. The output of the fifteen manufacturers engaged in the business is distributed by a joint sales agency.

An internationally-owned chlorine plant is scheduled to begin operations in Finland at the end of the current year. The initial 3,000 metric tons capacity of the plant is said to be inadequate for Finnish consumption and provisions have been made to extend it to 5,000 tons later.

The Bureau of Mines has just issued a report which says that the market demand for liquefied petroleum gases, exclusive of exports, increased 38.8 per cent in 1936 compared with 1935, according to reports submitted to the United States Bureau of Mines, Department of the Interior. Sales of liquefied petroleum gases for domestic use, gas manufacturing, industrial fuel and chemical manufacturing, and fuel for internal-combustion engines totaled 106,652,000 gal. in 1936 compared with 76,855,000 gal. in 1935. Exports of liquefied petroleum gases increased from 4,237,000 gal. in 1935, to 4,897,000 gal. in 1936, a gain of 15.6 per cent.

A review of the market requirements for the various liquefied gases shows that sales of propane increased from 26,814,000 gal. in 1935 to 36,502,000 gal. in 1936, a gain of 36.1 per cent. Deliveries of butane, which are larger in volume than any of the liquefied petroleum gases, increased to 47,455,000 gal. in 1936, or 39.2 per cent over the 1935 total of 34,084,000 gal.

CHEM. & MET. Weighted Index of CHEMICAL PRICES

Base = 100 for 1927

This month	88.53
Last month	88.20
June, 1936	86.24
June, 1935	87.45

Turpentine continues to hold an irregular course with an easy trend. Most of the heavy chemicals are steady. An advance in price for sulphate of ammonia was important in moving the index number upward.

CHEM. & MET. Weighted Index of Prices for OILS AND FATS

Base = 100 for 1927

This month	99.16
Last month	101.68
June, 1936	80.46
June, 1935	92.90

The majority of price changes favored the buying side but some selections either were unchanged or were slightly higher so that the drop in the index number was not so abrupt as in the preceding month.

Current PRICES

INDUSTRIAL CHEMICALS

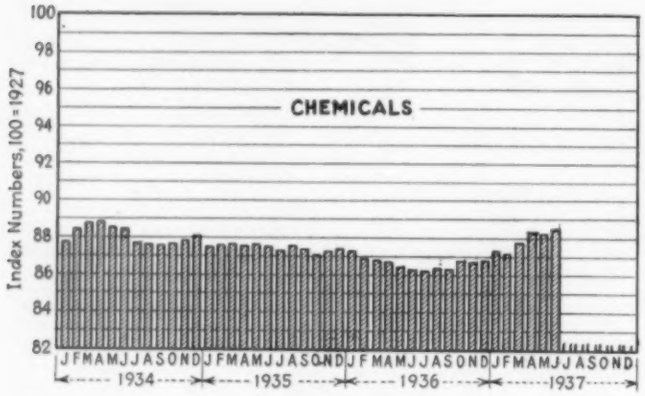
	Current Price	Last Month	Last Year
Acetone, drums, lb.	$0.06 –$0.07	$0.06 –$0.07	$0.08½–$0.09
Acid, acetic, 28%, bbl., cwt.	2.53 – 2.78	2.53 – 2.78	2.45 – 2.70
Glacial 99%, drums	8.70 – 8.95	8.70 – 8.95	8.43 – 8.68
U. S. P. reagent	10.75 –11.00	10.75 –11.00	10.52 –10.77
Boric, bbl., ton	105.00–115.00	105.00–115.00	105.00–115.00
Citric, kegs, lb.	.25 – .28	.25 – .28	.27 – .30
Formic, bbl., ton	.11 – .11½	.11 – .11½	.11 – .11½
Gallic, tech., bbl., lb.	.60 – .65	.60 – .65	.60 – .65
Hydrofluoric 30% carb., lb.	.07 – .07½	.07 – .07½	.07 – .07½
Lactic, 44%, tech., light, bbl., lb.	.06½– .06¾	.06½– .06¾	.11½– .12
Muriatic, 18°, tanks, cwt.	1.00 – 1.10	1.00 – 1.10	1.00 – 1.10
Nitric, 36°, carboys, lb.	.05 – .05½	.05 – .05½	.05 – .05¼
Oleum, tanks, wks., ton	18.50 –20.00	18.50 –.....	18.50 –20.00
Oxalic, crystals, bbl., lb.	.10½– .12	.10½– .12	.11½– .12½
Phosphoric, tech., c'bys., lb.	.09 – .10	.09 – .10	.09 – .10
Sulphuric, 60°, tanks, ton	11.00 –11.50	11.00 –11.50	11.00 –11.50
Sulphuric, 66°, tanks, ton	15.50 –.....	15.50 –.....	15.50 –.....
Tannic, tech., bbl., lb.	.26 – .30	.26 – .30	.23 – .35
Tartaric, powd., bbl., lb.	.23½– .24½	.22½– .23½	.24 – .25
Tungstic, bbl., lb.	2.50 – 2.75	2.50 – 2.75	2.50 – 2.75
Alcohol, Amyl	.....	.....	.....
From Pentane, tanks, lb.	.123–.....	.123–.....	.143–.....
Alcohol, Butyl, tanks, lb.	.08½–.....	.08½–.....	.08½–.....
Alcohol, Ethyl, 190p'f., bbl., gal.	4.14 –.....	4.14 –.....	4.27½–.....
Denatured, 190 proof	.....	.....	.....
No. 1 special, dr., gal wks.	.32 –.....	.32 –.....	.34 –.....
Alum, ammonia, lump, bbl., lb.	.03 – .04	.03 – .04	.03 – .04
Potash, lump, bbl., lb.	.03 – .04	.03 – .04	.03 – .04
Aluminum sulphate, com bags cwt.	1.35 – 1.50	1.35 – 1.50	1.35 – 1.50
Iron free, bg., cwt.	2.00 – 2.25	2.00 – 2.25	2.00 – 2.25
Aqua ammonia, 26°, drums, lb.	.02½– .03	.02½– .03	.02½– .03
tanks, lb.	.02½– .02¾	.02½– .02¾	.02½– .02¾
Ammonia, anhydrous, cyl., lb.	.15½– .16	.15½– .16	.15½– .16
tanks, lb.	.04½–.....	.04½–.....	.04½–.....
Ammonium carbonate, powd tech., casks, lb.	.08 – .12	.08 – .12	.08 – .12
Sulphate, wks., cwt.	1.425–.....	1.35 –.....	1.20 –.....
Amylacetate tech., tanks, lb.	.11 – .11½	.11 – .11½	.12 –.....
Antimony Oxide, bbl., lb.	.16 – .16½	.16 – .16½	.13½– .14
Arsenic, white, powd., bbl., lb.	.03 – .03½	.03 – .03½	.03½– .04
Red, powd., kegs, lb.	.15½– .16	.15½– .16	.15½– .16
Barium carbonate, bbl., ton	56.50 –58.00	56.50 –58.00	56.50 –58.00
Chloride, bbl., ton	72.00 –74.00	72.00 –74.00	72.00 –74.00
Nitrate, cask, lb.	.08½– .09	.08½– .09	.08½– .09
Blanc fixe, dry, bbl., lb.	.03½½ .04	.03½– .04	.03½– .04
Bleaching powder, f. o. b., wks., drums, cwt.	2.00 – 2.10	2.00 – 2.10	2.00 – 2.10
Borax, gran., bags, ton	46.00 –51.00	44.00 –49.00	44.00 –49.00
Bromine, cs., lb.	.36 – .38	.36 – .38	.36 – .38
Calcium acetate, bags	2.25 –.....	2.25 –.....	2.10 –.....
Arsenate, dr., lb.	.06½– .07	.06½– .07	.06 – .07
Carbide drums, lb.	.05 – .06	.05 – .06	.05 – .06
Chloride, fused, dr., del., ton	20.00 –33.00	20.00 –33.00	20.00 –33.00
flake, dr., del., ton	22.00 –35.00	22.00 –35.00	22.00 –35.00
Phosphate, bbl., lb.	.07½– .08	.07½– .08	.07½– .08
Carbon bisulphide, drums, lb.	.05½– .06	.05½– .06	.05½– .06
Tetrachloride drums, lb.	.05½– .08½	.05½– .06	.05½– .06
Chlorine, liquid, tanks, wks., lb.	2.15 –.....	2.15 –.....	2.15 –.....
Cylinders	.05½– .06	.05½– .06	.05½– .06
Cobalt oxide, cans, lb.	1.41 – 1.51	1.41 – 1.41	1.41 – 1.51
Copperas, bgs., f.o.b., wks., ton	15.00 –16.00	15.00 –16.00	15.00 –16.00
Copper carbonate, bbl., lb.	11½– .19½	.11½– .19	.11½– .16
Sulphate, bbl., cwt.	5.15– 5.40	5.40 – 5.65	4.00 – 4.25
Cream of tartar, bbl., lb.	.17½– .18	.16½– .17	.16½– .17
Diethylene glycol, dr., lb.	.16½– .20½	.16½– .20½	.16½– .20½
Epsom salt, dom., tech., bbl., cwt.	1.80 – 2.00	1.80 – 2.00	1.80– 2.00
Ethyl acetate, drums, lb.	.07 –.....	.07 –.....	.07 –.....
Formaldehyde, 40%, bbl., lb.	.05½– .06½	.05½– .06½	.06 – .07
Furfural, dr., lb.	.10 – .17½	.10 – .17½	.10 – .17½
Fusel oil, ref. drums, lb.	.16 – .18	.16 – .18	.16 – .18
Glaubers salt, bags, cwt.	.85 – 1.00	.85 – 1.00	.85 – 1.00
Glycerine, c.p., drums, extra, lb.	.23½–.....	.25½–.....	.14½– .15
Lead:			
White, basic carbonate, dry casks, lb.	.07½–.....	.07½–.....	.06½–.....
White, basic sulphate, sck., lb.	.07¼–.....	.07½–.....	.06 –.....
Red, dry, sck, lb.	.08½–.....	.08½–.....	.07 –.....
Lead acetate, white crys., bbl., lb.	.13½– .14	.13½– .14	.10½– .11
Lead arsenate, powd., bbl., lb.	.11½– .12	.11½– .12	.09 – .10
Lime, chem., bulk, ton	8.50 –.....	8.50 –.....	8.50 –.....
Litharge, pwd., csk., lb.	.07½–.....	.07½–.....	.06 –.....
Lithophone, bags, lb.	.04½– .04½	.04½– .04½	.04½– .05
Magnesium carb., tech., bags, lb.	.06 – .06½	.06 – .06½	.06 – .06¼
Methanol, 95%, tanks, gal.	.33 –.....	.33 –.....	.33 –.....
97%, tanks, gal.	.34 –.....	.34 –.....	.34 –.....
Synthetic, tanks, gal.	.33 –.....	.35½–.....	.35½–.....
Nickel salt, double, bbl., lb.	.13 – .13½	.13 – .13½	.13 – .13½
Orange mineral, csk., lb.	.11½–.....	.11½–.....	.10 –.....
Phosphorus, red, cases, lb.	.40 – .42	.40 – .42	.44 – .45
Yellow, cases, lb.	.24 – .30	.24 – .30	.28 – .32
Potassium bichromate, casks, lb.	.08½– .09	.08½– .09	.08½– .09
Carbonate, 80–85%, calc. csk., lb.	.07 – .07½	.07 – .07½	.07 – .07½
Chlorate, powd., lb.	.08½– .09	.08½– .09	.08 – .08½
Hydroxide (c'stic potash) dr., lb.	.07 – .07½	.07 – .07½	.06½– .06½
Muriate, 80% bgs., ton	23.00 –.....	23.00 –.....	22.00 –.....
Nitrate, bbl. lb.	.05½– .06	.05½– .06	.05½– .06
Permanganate, drums, lb.	.18½– .19	.18½– .19	.18½– .19
Prussiate, yellow, casks, lb.	.15 – .16	.15 – .16	.18 – .19
Sal ammoniac, white, casks, lb.	.05 – .05½	.05 – .05½	.04½– .05
Salsoda, bbl., cwt.	1.00 – 1.05	1.00 – 1.05	1.00 – 1.05
Salt cake, bulk, ton	13.00 –15.00	13.00 –15.00	13.00 –15.00
Soda ash, light, 58%, bags, contract, cwt.	1.23 –.....	1.23 –.....	1.23 –.....
Dense, bags, cwt.	1.25 –.....	1.25 –.....	1.25 –.....
Soda, caustic, 76%, solid, drums, contract, cwt.	2.60 – 3.00	2.60 – 3.00	2.60 – 3.00
Acetate, works, bbl., lb.	.04½– .05	.04½– .05	.04½– .05
Bicerbonate, bbl., cwt.	e1.75 – 2.00	1.75 – 2.00	1.85 – 2.00
Bichromate, casks, lb.	.06½– .07	.06½– .07	.06½– .07
Bisulphate, bulk, ton	15.00 –16.00	15.00 –16.00	15.00 –16.00
Bisulphite, bbl., lb.	.03½– .04	.03½– .04	.03 – .04
Chlorate, kegs, lb.	.06½– .06½	.06½– .06½	.06½– .06½
Chloride, tech., ton	12.00 –14.75	12.00 –14.75	12.00 –14.75
Cyanide, cases, dom., lb.	.16½– .17	.16½– .17	.15½– .16
Fluoride, bbl., lb.	.07½– .08	.07½– .08	.07½– .08
Hyposulphite, bbl., cwt.	e2.40 – 2.50	2.40 – 2.50	2.40 – 2.50
Metasilicate, bbl., cwt.	2.15 – 3.15	2.15 – 3.15	2.90 – 3.00
Nitrate, bags, cwt.	1.375–.....	1.375–.....	1.325–.....
Nitrite, casks, lb.	.07½– .08	.07½– .08	.07½– .08
Phosphate, dibasic, bbl., lb.	.022– .023	.022– .023	.022– .024
Prussiate, yel. drums, lb.	.10 – .11	.10– .11	.11½– .12
Silicate (40° dr.) wks., cwt.	.80 – .85	.80 – .85	.80 – .85
Sulphide, fused, 60–62%, dr., lb.	.02½– .03½	.02½– .03	.02½– .03
Sulphite, cyrs., bbl., lb.	.02½– .02¾	.02½– .02¾	.02½– .02¾
Sulphur, crude at mine, bulk, ton	18.00 –.....	18.00 –.....	18.00– .....
Chloride, dr., lb.	.03 – .04	.03½– .04	.03½– .04
Dioxide, cyl., lb.	.07 – .08	.06½– .08	.07 – .07½
Flour, bag, cwt.	1.60 – 3.00	1.60 – 3.00	1.60 – 3.00
Tin Oxide, bbl., lb.	.58 –.....	.58 –.....	.50 –.....
Crystals, bbl., lb.	.40½–.....	.40 –.....	.34½–.....
Zinc. chloride, gran., bbl., lb.	.05 – .06	.05 – .06	.05 – .06
Carbonate, bbl., lb.	.14 – .15	.14 – .15	.09 – .11
Cyanide, dr., lb.	.36 – .38	.36 – .38	.36 – .38
Dust, bbl., lb.	.085–.....	.0865–.....	.069– .07
Zinc oxide, lead free, bag., lb.	.06 –.....	.06 –.....	.05 –.....
5% lead sulphate, bags, lb.	.05½–.....	.05½–.....	.04½–.....
Sulphate, bbl., cwt.	3.15 – 3.60	3.15 – 3.60	2.65 – 3.00

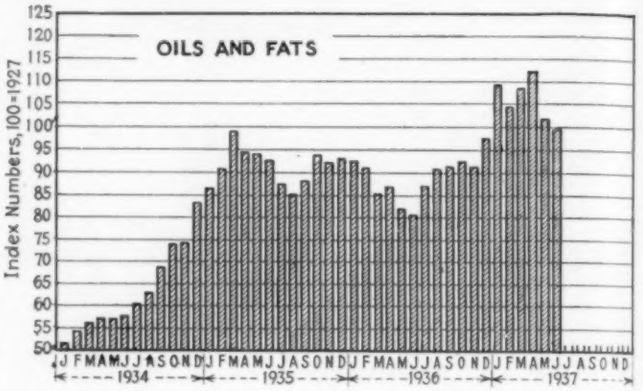
The accompanying prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to June 11

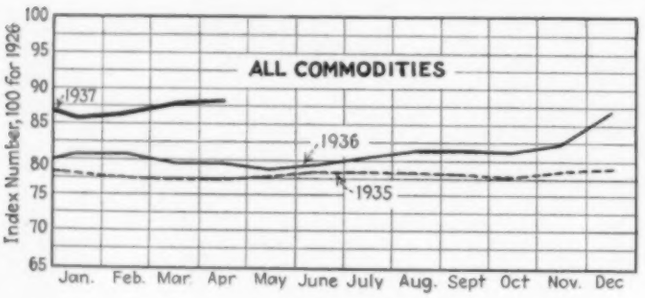
OILS AND FATS

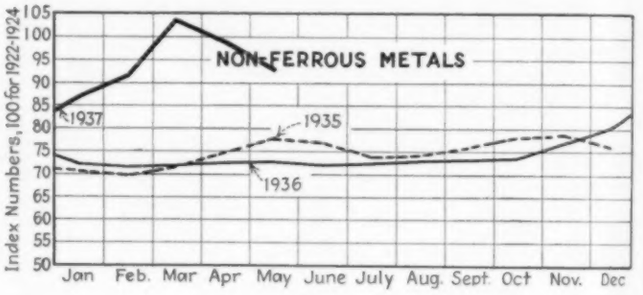
	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb.	$0.10½–$0.11	$0.10½–$0.11	$0.10 –$0.11
Chinawood oil, bbl., lb.	.13 –.....	.14½–.....	.18½–.....
Coconut oil, Ceylon, tanks, N. Y. lb.	.06½–.....	.07½–.....	.04 –.....
Corn oil crude, tanks (f.o.b. mill), lb.	.08½–.....	.09 –.....	.08 –.....
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.....	.08½–.....	.08 –.....
Linseed oil, raw car lots, bbl., lb.	.11l–.....	.11l–.....	.094–.....
Palm, casks, lb.	.06 –.....	.06 –.....	.04½–.....
Peanut oil, crude, tanks (mill), lb.	.09½–.....	.09½–.....	.08 –.....
Rapeseed oil, refined, bbl., gal.	.93 –.....	.93 –.....	.51 –.....
Soya bean, tank, lb.	.10 –.....	.09 –.....	.06 –.....
Sulphur (olive foots), bbl., lb.	.12 –.....	.12 –.....	.08 –.....
Cod, Newfoundland, bbl., gal.	.52 –.....	.52 –.....	.40 –.....
Menhaden, light pressed, bbl., lb.	.11 –.....	.09 –.....	.06 –.....
Crude, tanks (f.o.b. factory), gal.	.45 –.....	.43½–.....	.32 –.....
Grease, yellow, loose, lb.	.08½–.....	.08½–.....	.03½–.....
Olio stearine, lb.	.09½–.....	.09½–.....	.07 –.....
Red oil, distilled, d.p. bbl., lb.	.10½–.....	.10½–.....	.08½–.....
Tallow extra, loose, lb.	.08½–.....	.09½–.....	.04½–.....

CHEM. & MET.'S WEIGHTED PRICE INDEXES









COAL-TAR PRODUCTS

	Current Price	Last Month	Last Year
Alpha-napthol, crude, bbl., lb.	$0.52 –$0.55	$0.52 –$0.55	$0.60 –$0.62
Alpha-naphthylamine, bbl., lb.	.32 – .34	.32 – .34	.32 – .34
Aniline oil, drums, extra, lb.	.15 – .16	.15 – .16	.14½– .15
Aniline salts, bbl., lb.	.24 – .25	.24 – .25	.24 – .25
Benzaldehyde, U.S.P., dr., lb.	1.10 – 1.25	1.10 – 1.25	1.10 – 1.25
Benzidine base, bbl., lb.	.65 – .67	.65 – .67	.65 – .67
Benzoic acid, U.S.P., kgs., lb.	.52 – .54	.52 – .54	.48 – .52
Benzyl chloride, tech., dr., lb.	.40 – .42	.40 – .42	.30 – .35
Benzol, 90%, tanks, works, gal.	.16 – .18	.16 – .18	.18 – .20
Beta-napthol, tech., drums, lb.	.23 – .24	.23 – .24	.24 – .27
Cresol, U.S.P., dr., lb.	.12 – .13	.10 – .11	.11 – .11½
Cresylic acid, 99%, dr., wks., gal.	.92 – 1.00	.90 – 1.00	.58 – .60
Diethylaniline, dr., lb.	.55 – .58	.55 – .58	.55 – .58
Dinitrophenol, bbl., lb.	.23 – .25	.23 – .25	.29 – .30
Dinitrotoluen, bbl., lb.	.15 – .16	.15 – .16	.16 – .17
Dip oil, 25%, dr., gal.	.23 – .25	.23 – .25	.23 – .25
Diphenylamine, bbl., lb.	.32 – .36	.32 – .36	.38 – .40
H-acid, bbl., lb.	.50 – .55	.50 – .55	.65 – .70
Naphthalene, flake, bbl., lb.	.07½– .07½	.07½– .07½	.07 – .08
Nitrobenzene, dr., lb.	.08½– .09	.08½– .09	.08½– .10
Para-nitraniline, bbl., lb.	.45 – .47	.45 – .47	.51 – .55
Phenol, U.S.P., drums, lb.	.13½– .14	.13½– .14	.14½– .15
Picric acid, bbl., lb.	.30 – .40	.30 – .40	.30 – .40
Pyridine, dr., gal.	1.55 – 1.60	1.30 – 1.35	1.10 – 1.15
Resorcinal, tech., kegs, lb.	.75 – .80	.75 – .80	.65 – .70
Salicylic acid, tech., bbl., lb.	.34 – .40	.34 – .40	.40 – .42
Solvent naptha, w.w., tanks, gal.	.30 –.....	.30 –.....	.26 –.....
Tolidine, bbl., lb.	.88 – .90	.88 – .90	.88 – .90
Toluene, tanks, works, gal.	.35 –.....	.35 –.....	.30 –.....
Xylene, com, tanks, gal.	.35 –.....	.35 –.....	.30 –.....

MISCELLANEOUS

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton.	$22.00–$25.00	$22.00–$25.00	$22.00–$25.00
Casein, tech., bbl., lb.	.13 – .14	.13½– .15	.15 – .17
China clay, dom., f.o.b. mine, ton.	8.00 –20.00	8.00 –20.00	8.00 –20.00
Dry colors:			
Carbon gas, black (wks.), lb.	.04 – .20	.04 – .20	.04 – .20
Prussian blue, bbl., lb.	.37 – .38	.37 – .38	.37 – .38
Ultramarine blue, bbl., lb.	.10 – .26	.10 – .26	.10 – .26
Chrome green, bbl., lb.	.26 – .27	.26 – .27	.26 – .27
Carmine red, tins, lb.	4.00 – 4.40	4.00 – 4.40	4.00 – 4.40
Para toner, lb.	.75 – .80	.75 – .80	.80 – .85
Vermilion, English, bbl., lb.	1.80 – 1.90	1.72 – 1.75	1.59 – 1.60
Chrome yellow, C. P., bbl., lb.	.13 – .14	.13 – .14	.12 – .14
Feldspar, No. 1 (f.o.b. N.C.), ton.	6.50 – 7.50	6.50 – 7.50	6.50 – 7.50
Graphite, Ceylon, lump, bbl., lb.	.06 – .06½	.07 – .08½	.07 – .08½
Gum copal Congo, bags, lb.	.08 – .30	.08 – .30	.08 – .30
Manila, bags, lb.	.08½– .14	.08½– .14	.08½– .14
Damar, Batavia, cases, lb.	.15½– .23	.15½– .23	.15½– .16
Kauri cases, lb.	.17½– .60	.17½– .60	.20 – .25
Kieselguhr (f.o.b. N. Y.), ton.	50.00 –55.00	50.00 –55.00	50.00 –55.00
Magnesite, calc, ton.	50.00 –.....	50.00 –.....	50.00 –.....
Pumice stone, lump, bbl., lb.	.05 – .07	.05 – .08	.05 – .07
Imported, casks, lb.	.03 – .40	.03 – .40	.03 – .35
Rosin, H., bbl.	9.35 –.....	9.55 –.....	5.65 –.....
Turpentine, gal.	.39 –.....	.42 –.....	.41 –.....
Shellac, orange, fine, bags, lb.	.24 –.....	.24 –.....	.25 –.....
Bleached, bonedry, bags, lb.	.18 –.....	.19 –.....	.19 –.....
T. N. Bags, lb.	.12½–.....	.13 –.....	.14½–.....
Soapstone (f.o.b. Vt.), bags, ton.	10.00 –12.00	10.00 –12.00	10.00 –12.00
Talc, 200 mesh (f.o.b. Vt.), ton.	8.00 – 8.50	8.00 – 8.50	8.00 – 8.50
300 mesh (f.o.b. Ga.), ton.	7.50 –10.00	7.50 –10.00	7.50 –11.00
225 mesh (f.o.b. N. Y.), ton.	13.75 –.....	13.75 –.....	13.75 –.....

INDUSTRIAL NOTES

ALLIS-CHALMERS MFG. CO., Milwaukee, has opened an office in Knoxville, Tenn., with W. C. Johnson in charge.

AMERICAN CYANAMID & CHEMICAL CORP., New York, has moved its Detroit office to the Fisher Bldg.

CANADIAN FAIRBANKS-MORSE CO., LTD., with offices in Toronto, Montreal, Quebec, and in twelve other Canadian centers, has been appointed sales agent for Traylor equipment for all of Canada except British Columbia.

CUTLER-HAMMER, INC., Milwaukee, has opened a sales office in the Santa Fe Bldg., Dallas, Texas.

C. O. BARTLETT & SNOW CO., Cleveland, has moved its New York office to 30 Church St., where C. W. Ross will continue as business manager.

THE BROWN INSTRUMENT CO., a division of Minneapolis-Honeywell Regulator Co., Philadelphia, has appointed E. B. Evleth as vice-president and general manager to succeed W. J. Hajek, retired.

THE PATTERSON FOUNDRY & MACHINE CO., East Liverpool, Ohio, has opened an office in the Bessemer Bldg., Pittsburgh, with D. M. Wilhelm in charge.

New CONSTRUCTION

Where Plants Are Being Built in Process Industries

	Current Projects		Cumulative 1937	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	$45,000	$40,000	$775,000	$1,160,000
Middle Atlantic	865,000	649,000	11,022,000	7,141,000
South	2,050,000	.....	4,365,000	22,951,000
Middle West	130,000	725,000	10,733,000	9,177,000
West of Mississippi	130,000	470,000	7,180,000	4,671,000
Far West	400,000	75,000	3,200,000	4,978,000
Canada	6,130,000	490,000	9,935,000	861,000
Total	$9,750,000	$2,449,000	$47,210,000	$50,939,000

PROPOSED WORK

Carbon Black Plant—Echlin Carbon Development Syndicate, Craigmyle, Alta., Can., is having plans prepared by Kribs & Lynar, Engrs., 603 Harbor Bldg., Toronto, Ont., Can., for a plant for carbon black extraction as a by-product of natural gas.

Carbon Black Plant—General Atlas Carbon Co., c/o Cities Service Co., 60 Wall St., New York, N. Y., plans to construct a carbon black chemical plant near Guymon, Okla. Estimated cost will exceed $50,000.

Chemical Plant—E. I. du Pont de Nemours & Co., Buffalo Ave., Niagara Falls, N. Y., plans to construct a 3 story, 30x122 ft. addition to its chemical plant here. Estimated cost $50,000.

Chemical Plant—Ethyl-Dow Chemical Co., Kure Beach, Wilmington, N. C., plans to construct a chemical plant. Estimated cost $1,000,000.

Clay Products Plant—Grand Lodge Clay Products Co., Grand Lodge, Mich., plans to repair and rebuild its plant here. Maturity indefinite. $40,000.

Distillery—Brown Vintners Co., 630 Fifth Ave., New York, N. Y., has acquired the plant formerly occupied by the Bristol Patent Leather Co., at Bristol, Pa., and will alter same into a distillery for its own use. Estimated cost will exceed $40,000.

Distillery — Distiller's Corporation-Seagram's, Ltd., Louisville, Ky., will soon take bids for the construction of a bottling plant at its distillery. Estimated cost $1,000,000.

Drug Factory—G. D. Searle & Co., manufacturer of proprietary drugs, Glencoe, Ill., plans to construct a factory at Niles Center, Ill. Estimated cost $50,000.

Glass Factory—Metro Glass Bottle Co., Westside Ave., Jersey City, N. J., contemplates improvements to its plant. Estimated cost including equipment will exceed $40,000. Maturity indefinite.

Glass Block Factory—Pittsburgh Corning Corp., J. P. Stapels in charge, Grant Bldg., Pittsburgh, Pa., is having plans prepared by Alfred Vaksdal, Engr., c/o Owner, for the construction of a factory for the manufacture of glass blocks at Port Allegheny, Pa. Estimated cost $500,000.

Plywood Mill—Port Angeles Plywood Corp., Port Angeles, Wash., plans to construct a plywood mill at Anacortes, Wash. C. Carlson, Tacoma, Engr. Estimated cost $400,000.

Pulp Mill—Lake Sulphide Pulp Co., Ltd., 132 St. James St., W., Montreal, Que., Can., is having plans prepared by C. D. Howe Co., Ltd., 712 Public Utility Bldg., Port Arthur, Ont., Can., for the construction of a pulp mill at Red Rock, Ont., Can. Estimated cost $6,000,000.

Refinery—Continental Oil Co., Ponca City, Okla., plans to improve its refinery at Britton, Okla. Estimated cost $80,000.

Oil Distillation Plant—Socony-Vacuum Oil Co., 1103 Elk St., Buffalo, N. Y., plans to construct an oil distillation plant. E. B. Badger & Sons Co., 75 Pitts St., Boston, Mass., Engr. Estimated cost will exceed $25,000.

Research Laboratory—Agfa Ansco Corp., Charles St., Binghamton, N. Y., is having plans prepared by Lockwood-Greene Engineers, Inc., 30 Rockefeller Plaza, New York, N. Y., for the construction of a 4 story research laboratory. Estimated cost $210,000.

Research Laboratory—Tyrrell Research Laboratory, Walter Tyrrell, owner, William Pitt Hotel Bldg., Chatham, Ont., Can., manufacturer of fabric cleansers, is having plans prepared by John Methven, Archt., 92½ King St., W., Chatham, for the construction of a factory. Estimated cost $35,000.

Rubber Factory—Armstrong Rubber Co., Inc., 475 Elm St., West Haven, Conn., is having plans prepared by Fletcher-Thompson, Inc., 1336 Fairfield Ave., Bridgeport, Conn., for a 3 story factory. A Bambury Mixer will be installed. Estimated cost $45,000.

Rubber Factory—Firestone Tire & Rubber Co., Akron, O., has purchased a 100 acre site at Riverview near Wyandotte, Mich., and plans to construct a rubber products plant.

Rubber Roller Factory—General Asbestos & Rubber Co., division of Raybestos-Manhattan, North Charleston, S. C., contemplates the construction of a rubber roller factory. Estimated cost $50,000.

Soap Factory—Andrew Jergens Co., Ltd., Perth, Ont., Can., is having plans prepared by Richards & Albra, Archts., 35 Metcalfe St., Ottawa, Ont., Can., for the construction of a 1 story, 65x160 ft. factory. Additional equipment will be installed. Estimated cost $55,000.

CONTRACTS AWARDED

Chemical Factory—Dewey & Almy Chemical Co. of Canada, Ltd., 20 Gray Nun St., Montreal, Que., Can., has awarded the contract for the construction of a factory on Wauklyn St., Ville La Salle, Que., to Foss Engineering Co., Ltd., Montreal, Que. Estimated cost $75,000.

Distillery—Rochester Distilling Co., 926 Exchange St., Rochester, N. Y., has acquired a plant here and will convert it into a distillery for its own use. Contract has been awarded to Stewart & Bennett, Inc., 126 North Water St., Rochester.

Factory—Century Silica Co., c/o Frank Wilson, Constr. Engr. and Vice Pres., Orrville, O., has awarded separate contracts for modernizing its silica sand plant between Emlenton and Foxburg, Clarion Co., Pa. Equipment contracts have been awarded to Harding Co., York, Pa., and Birdsboro Steel Foundry Co., Birdsboro, Pa. Estimated cost $250,000.

Factory—E. I. du Pont de Nemours & Co., Inc., fabrikoid division, Newburgh, N. Y., will alter and construct an addition to its factory here. Work will be done by owner's forces under supervision of S. Alverts. Estimated cost will probably exceed $40,000 with equipment.

Factory—Eastman Kodak Co., Kodak Park, Rochester, N. Y., has awarded the contract for an 8 story factory to Ridge Construction Corp., Kodak Park, Rochester. Estimated cost $207,000.

Factory—American Napthalene Co. has awarded the contract for the construction of a naphthalene cyanide plant on Baxart St., Pachester, N. Y., to Davis & Averill, Inc., 28 Fulton St., Newark, N. J. Address owner care of contractor. Estimated cost $50,000.

Factory—Ferro Enamel Corp., L. F. Sieferd, Plant Eng., 4150 East 56th St., Cleveland, O., has awarded the contract for a factory and storage addition to H. K. Ferguson Co., Hanna Bldg., Cleveland, O. Estimated cost $100,000.

Factory—Sten Fiber Co., Charles J. Sten, Mgr., 5403 Bower Ave., Cleveland, O., has awarded the contract for a factory at Ashtabula, O., to Dresser Co., The Arcade, Cleveland. Estimated cost $40,000.

Factory—Linde Air Products Co., 30 East 42nd St., New York, N. Y., has awarded the contract for an addition to its plant at 900 Walnut St., Utica, N. Y., to Bart J. Ruddy, Inc., 1147 Mohawk St., Utica. Estimated cost including equipment $40,000.

Factory—Niagara Sprayer & Chemical Co., Inc., Middleport, N. Y., has awarded the contract for an addition to its factory to Laur & Mack, 1400 College Ave., Niagara Falls, N. Y. Estimated cost including equipment $40,000.

Factory—The Paraffine Companies, Inc., foot Powell St., Emeryville, Calif., manufacturer of roofing, linoleum and paper, has awarded the contract for an addition to its plant to Clinton Construction Co., 923 Folsom St., San Francisco. Estimated cost will exceed $75,000.

Ink Factory—Bradentown-Sutphin Ink Co., 1736 East 22nd St., Cleveland, O., has awarded the contract for a 3 story factory building to Gillmore-Carmichael-Olson Co., 1873 East 55th Ct., Cleveland. Estimated cost $125,000.

Laboratory—Electrical Testing Laboratories, 2 East End Ave., New York, N. Y., have awarded the contract for a factory and laboratory to William Ginsburg, 331 Madison Ave., New York, N. Y. Estimated cost $140,000.

Laboratory — International Nickel Co., Copper Cliff, Ont., Can., is building a 3 story brick laboratory building. Special equipment will be installed. Estimated cost $375,000.

Laboratory—Miles Laboratories, 117-23 West Franklin St., Elkhart, Ind., has awarded the contract for a 3 story, 187x351 ft. pharmaceutical building including research laboratories to Sollitt Construction Co., 109 North Dearborn St., Chicago, Ill.

Laboratory—National Advisory Committee for Aeronautics, Washington, D. C., has awarded the contract for superstructure for laboratory at Langley Field, Hampton, Va., to Harwood Construction Ct., Norfolk. $78,500; foundation to C. W. Luckwood, Norfolk, $13,395.

Laboratory—Refrigeration & Air Conditioning Institute, 2150 Lawrence Ave., Chicago, Ill., has awarded the contract for an addition to its laboratory to Austin Co., 510 North Dearborn St., Chicago, Ill. Estimated cost $80,000.

Laboratory—United Aircraft Corp., South Main St., East Hartford, Conn., has awarded the contract for a testing laboratory to R. G. Bent Co., 93 Edwards St., Hartford, Conn. Estimated cost $40,000.

Research Laboratory—Shell Petroleuem Corp., 1221 Locust St., St. Louis, Mo., has awarded the contract for a 117x147x162 ft. "U" shaped testing laboratory at Wood River, Ill., to Vernon Higbee Construction Co., 6504 Nashville Ave., St. Louis.

Paint Factory—Artcraft Paints, Ltd., 313 Symington Ave., Toronto, Ont., Can., has its factory to James W. Hewitt & Sons, 56 Roncesvalles Ave., Toronto. Estimated cost $40,000.

Paper Mill—Kalamazoo Paper Co., Kalamazoo, Mich., has awarded the contract for the construction of a mill to Miller & Davis, Kalamazoo, Mich. Estimated cost $40,000.

Refinery—Gulf Oil Corp., 17 Battery Pl., New York, N. Y., has awarded the contract for a Iso-Octane unit at its refinery at Port Arthur, Tex., to Lummus Co., 50 Church St., New York, N. Y. Estimated cost $300,000.

Refinery—Refugio Refining Co., Edinburg, Tex., will construct a casinghead gasoline plant at La Blanca near Edinburg. Work will be done by day labor. Estimated cost $80,000.

Rock Wool Mill—Rock Wool Co., R. W. Ross, Pres., Lagro, Ind., will construct a rock wool insulating mill. Work will be done by day labor. Estimated cost $50,000.

Starch Factory—Faultless Starch Co., 1025 West 8th St., Kansas City, Mo., will build a 6 story, 40x124 ft. addition to its starch factory. Work will be done by separate contracts.

PRODUCTION OF MISCELLANEOUS CHEMICALS—PART 2

Census Data for 1935

Miscellaneous chemicals, value...	$223,294,280
Bicarbonates and carbonates, value	$36,667,113
Sodium bicarbonate, refined (basis 100 percent):	
Establishments	4
Tons (basis 100 percent)	136,556
Value	$3,658,321
Bismuth, subcarbonate:	
Establishments	6
Pounds	231,432
Value	$364,265
Copper carbonate:	
Establishments	6
Pounds[2]	337,236
Value	$89,536
Soda ash:	
Establishments	17
Total production, tons	2,508,859
Made and consumed, tons	637,224
For sale:	
Tons	1,871,635
Value	$28,424,750
For sale, by process:	
Ammonia soda:	
Establishments	9
Tons	1,776,470
Value	$27,212,035
Natural and electrolytic soda:	
Establishments	8
Tons	[3]95,165
Value	$1,212,715
Calcium carbonate:	
Establishments	6
Tons	33,921
Value	$859,649
Magnesium carbonate, precipitated:	
Establishments	7
Tons	7,301
Value	$877,741
Potassium carbonate:	
Establishments	5
Pounds	11,712,225
Value	$643,164
Sal soda:	
Establishments	17
Tons	30,439
Value	$1,021,308
Other bicarbonates and carbonates, value	$728,379
Chlorides, value	$16,861,430
Aluminum (anhydrous, crystal and liquid):	
Establishments	10
Tons[2]	2,339
Value	$397,295
Calcium[4]:	
Solid:	
Establishments	5
Tons (basis 73–75 percent)	7,526
Value	$108,548
Flake:	
Establishments	4
Tons (basis 73–79 percent)	197,948
Value	$3,205,727
Liquid:	
Establishments	5
Tons (basis 75 percent)	21,527
Value	$314,613
Iron, ferric and ferrous:	
Establishments	14
Pounds[2]	11,318,416
Value	$291,875
Sulphur:	
Establishments	4
Pounds	76,362,340
Value	$1,178,804
Tin, stannic:	
Establishments	7
Pounds	15,640,763
Value	$3,976,487
Tin, stannous:	
Establishments	7
Pounds	477,229
Value	$174,811
Ammonia (sal ammoniac):	
Establishments	7
Pounds	28,015,734
Value	$1,242,261
Other chlorides, value	[5]$4,819,559
Linoleates, value	$127,971
Oxalates, value	$148,984
Oxides, value	$9,867,831
Aluminum (abrasive):	
Establishments	4
Tons	22,035
Value	$3,852,141
Tin:	
Establishments	7
Pounds	3,245,462
Value	$1,685,692
Chromium:	
Establishments	7
Pounds	3,480,585
Value	$756,708
Other oxides, value	[6]$3,431,368
Peroxides, value	$3,856,375
Hydrogen:	
Establishments	10
Pounds (basis 100 volume)	17,409,092
Value	$3,154,593
Other peroxides, value	[7]$701,782
Phosphates, value	$14,189,220
Monobasic:	
Establishments	10
Tons	35,862
Value	$4,665,301
Dibasic:	
Establishments	6
Tons	2,714
Value	$208,035
Tribasic:	
Establishments	5
Tons	2,015
Value	$242,249
Sodium:	
Tribasic:	
Establishments	14
Tons	87,108
Value	$3,861,952
Dibasic:	
Establishments	12
Tons	35,434
Value	$1,337,711
Meta:	
Establishments	4
Tons	5,147
Value	$519,708
Monobasic and pyro:	
Establishments	6
Tons	4,517
Value	$832,724
Other phosphates, value	[8]$2,521,540
Sulphates, value	$21,404,993
Aluminum:	
Establishments	22
Tons	348,030
Value	$7,748,490
Aluminum-ammonium:	
Establishments	7
Tons	5,187
Value	$259,292
Barium (blanc fixé):	
Establishments	12
Pounds	10,550,507
Value	$317,004
Copper (blue vitriol):	
Establishments	14
Pounds	54,395,039
Value	$1,911,099
Iron (copperas):	
Establishments	23
Tons	31,852
Value	$311,516
Magnesium (Epsom salt):	
Establishments	5
Tons	38,489
Value	$1,116,534
Manganese:	
Establishments	4
Pounds[9]	6,211,704
Value	$190,620
Potash and chrome alums:	
Establishments	5
Tons	2,666
Value	$156,684
Sodium, value	$4,262,546
Anhydrous (refined):	
Establishments	8
Tons	[10]23,609
Value	[11]$457,890
Glauber's salt:	
Establishments	19
Tons	[11]39,961
Value	[11]$542,251
Hyposulphite (thiosulphate):	
Establishments	8
Tons	24,477
Value	$1,054,264
Niter cake:	
Establishments	20
Production, tons	28,162
Salt cake (crude):	
Establishments	27
Tons	[12]169,842
Value	[12]$1,864,251
Sodium - aluminum (soda alum):	
Establishments	3
Tons	18,040
Value	$1,030,415
Zinc:	
Establishments	10
Pounds	37,006,565
Value	$721,025
Other sulphates, value	[13]$3,379,768
Miscellaneous inorganic, value	$120,170,363
Ammonia, aqua and liquor:	
Establishments	17
Pounds (NH_3 content)	17,173,768
Value	$1,075,036
Bismuth subgallate:	
Establishments	5
Pounds	24,328
Value	$38,686
Calcium carbide:	
Establishments	6
Tons	147,092
Value	$6,234,380
Calcium oxychloride (bleaching powder):	
Establishments	16
Tons[14]	39,561
Value	$909,071
Iodine, resublimed:	
Establishments	6
Pounds	119,816
Value	$238,357
Ferro-alloys, electric-furnace:	
Establishments	17
Tons (2,240 pounds)	216,529
Value	$23,476,247
Mercury, ammoniated:	
Establishments	6
Pounds	60,269
Value	$82,275
Mercury, redistilled:	
Establishments	5
Pounds	74,817
Value	$85,956
Sodium benzoate:	
Establishments	5
Pounds	1,354,893
Value	$391,352
Sodium borate (borax):	
Establishments	6
Tons	106,137
Value	$3,694,629
Sodium hypochlorite:	
Establishments	53
Tons[15]	50,807
Value	$4,728,921
Modified sodas:	
Soda ash and bicarbonate:	
Establishments	9
Tons	20,103
Value	$1,140,022
Sodium silicate:	
Liquid:	
Establishments	24
Tons (basis 40°)	648,827
Value	$6,607,204
Solid:	
Establishments	13
Tons	30,536
Value	$1,065,968
Sodium silicofluoride:	
Establishments	11
Tons	2,628
Value	$202,677
Sulphur, refined:	
Establishments	9
Tons	47,504
Value	$1,649,758
Other inorganics, value	[16]$55,660,919

[1] Data incomplete. [2] Production in 1935, basis 100 percent; for other years as reported, regardless of strength. [3] Electrolytic production was for interplant transfer and not for sale. [4] Data for calcium chloride produced by establishments engaged primarily in the production of salt are included in figures for 1933 and 1929 but not in those for 1935. This production in 1935, reported by 8 establishments, amounted to 8,044 tons, valued at $50,442. [5] Includes, in order of value, potassium chloride, zinc chloride, ethylene dichloride, barium chloride, ethyl chloride, etc. [6] Includes, in order of value, aluminum oxide, titanium oxide, antimony oxide, arsenic oxide, zinc oxide, etc. [7] Includes, in order of value, sodium peroxide, barium peroxide, etc. [8] Includes value of ammonium phosphate, etc. [9] Production in 1935, basis 100 percent; for 1933 as reported, regardless of strength. [10] Includes data for anhydrous sodium sulphate made from brines. [11] Includes data for Glauber's salt refined from natural product. [12] Includes data for natural salt cake made from brines. [13] Includes, in order of value, ammonium sulphate, lead sulphate, nickel sulphate, chromium sulphate, etc. [14] Production in 1935 and 1933, basis 35 to 37 percent; 1929 as reported, regardless of strength. [15] Production in 1935, basis 15 percent; for other years as reported, regardless of strength.